Building Adaptive Capacity: An Analysis of Innovations in Information and Communication Technology in Post-Earthquake Haiti

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Introduction:

As a small-island developing state, Haiti's extreme physical vulnerability is further compounded by current political and civil society conditions that further weaken its ability to anticipate and plan for future disaster events. In the aftermath of the January 2010 earthquake that devastated Port-au-Prince, the nation's core, discourse has increasingly recognized the physical and structural concentration of power as problematic. These critiques of the Haitian state have pointed towards a need for decentralization and autonomy from interceding foreign entities in order for Haiti to successfully plan for risk reduction and decrease its vulnerability to future disaster events. I will refer to this process as adaptation planning and through this paper will examine the role of recent innovations in Information and Communication Technology (ICT) in augmenting the adaptive capacity of the Haitian state to carry out these processes. As a critical subset of this, the role of the state in regulating intellectual property regimes to support intellectual capital will also be examined. This is necessary to promote the development of suitable and adaptable ICTs, which require specific institutional conditions that support domestic innovation and application development.

New ICTs that emerged in the humanitarian response to the 2010 earthquake, particularly mobile-based technologies, have been hyped for their ability to spatialize and organize disaster relief efforts and more broadly, to assist short-term mitigation efforts. The international community has also speculated about their ability to identify community need, and facilitate participation and information sharing amongst authorities, enhancing state efficiencies and paving the way towards social and physical resiliency. It becomes critical to assess the true utility of these technologies by understanding whether they can be adapted to idiosyncratic behaviors, innovation processes, and long-term uses or whether they will be phased out. If these platforms are to be adapted to more long-term needs and uses, a question of management and operation emerges; as implementing bodies and resources begin to filter out, who will continue the operation of complex new ICTs and adapt these platforms as need evolves? More importantly, who will these platforms be adapted for? It is the intention of my research to contribute to a

more robust understanding of the potentials and limitations of crowd-sourced and mobile ICTs for building adaptive capabilities and enhancing state functions in Haiti.

By analyzing communication workflows of three different mobile and open source platforms, Noula, SIS-KLOR, and OpenStreetmap, this study seeks to elucidate whether new information and communication technologies are a viable medium for enhancing the adaptive capacity of the Haitian state and to what extent they have been institutionalized and/or adapted to address long-term planning needs. I will assert that crowd-sourced and new information and communication technologies are too complex to be properly managed and/or developed by state entities. Local and regional agencies lack resources and capacity to process and compute information, while information is too localized for national level agencies to understand and accurately interpret. Even if state agencies were equipped with the necessary resources to manage platforms, I will argue that accessibility and path dependency issues prevent ICTs from accurately representing diversity since vast inequalities in accessibility exist between urban and rural populations as well as generationally. Were this to replace traditional means of communication and participation, this could lead to an undemocratic process that excludes those without the fiscal and technical means to communicate via technology. Since I place emphasis on the ability of Haitians to adapt these technologies to local need, this requires technical capacities and resources to innovate, develop, and manage new platforms domestically. For this reason, I also intend to investigate the role of the state in regulating intellectual property markets, which plays a role in encouraging or discouraging domestic innovations.

Background:

The January 2010 earthquake in Port-au-Prince, or the Goudougoudou, was a natural event but "the scale of the destruction was due to the massive failure of Haitian social institutions, namely the state, and international policy, which predated the earthquake" (Gros, 2011;133). As an island state with a tumultuous political economy, as well as disaster-prone environmental factors, Haiti has been consistently considered one of the most vulnerable developing states, particularly in the Western hemisphere. Global forces have created a state of dependency in Haiti with thousands of foreign organizations ranging from multinational corporations to small-scale NGO's superseding in developmental affairs. Foreign actors, oftentimes with dual agendas (inter-organization and funder-imposed), have been criticized for failing to address local needs and for exasperating the already frail state of national, regional, and local level governments by absorbing its human capital. Arguments have been made for the importance of increased political autonomy to coordinate development efforts and align projects with local needs to decrease Haiti's disaster risk. As evident from the 2010 earthquake, the coping mechanisms currently in place are inadequate and would not be able to sustain a repeat disaster. Building adaptive capacity therefore presents itself as a pressing issue to build resiliency.

The traditional humanitarian response[1] system faced significant challenges in Haiti given the lack of spatial information with which to organize the relief effort and parcel out areas of control, additionally there were no communication links between the response system and the disaster-affected communities. While prior disaster responses in Haiti have relied heavily on the leveraging of radio to distribute vital information, in the aftermath of the 2010 earthquake, all radio towers with the exception of one were in states of disrepair (Nelson & Sigal, 2011). Disaster affected-communities communicated with each other via telejol (word of mouth) and cell phones to try to locate family members, resources, etc. (Chery &

[1] The traditional humanitarian response is organized around the cluster system, in which a designated international organization will assume responsibility of a specific sector (water & sanitation, education, etc.). Teams are then further subdivided, dispatched, and given specific zones for which they are responsible for delivering and distributing resources (Urruela, 2012).

Wall, 2011). However, responders were unable to tap into this network due to language barriers and insufficient knowledge – this resulted in a very chaotic and disorganized response. According to one platform developer, who observed from his experience working with disaster affected communities and the humanitarian responders that "the public services and NGOs were more chaotic and disorganized than the small neighborhood associations [that were managing themselves]" (Jean-Charles, 2012). Since there was no means through which to distribute vital information, and no means for effectuating dialogue between responders and survivors, this led to the emergence of new forms of outreach to disaster-affected communities such as crowd-sourcing through mobile devices. Once radio stations began to resurface, combinations between the two media – or "mash-ups" - were leveraged to reach a broader range of citizens. These mash-ups were found to solicit two-way flows of communication so that responders could not only relay information to earthquake survivors but also receive information from the very communities they were attempting to assist. Examples of these are OpenStreetMap, Noula, and Ushahidi.

The international community has recognized such tools as agents for informing and coordinating emergency relief groups, as well as venues for catalyzing development through identification of community needs by the community itself. Further more, they can begin to address the issue of lack of available information - particularly geospatial information - since many of Haiti's archives were lost or destroyed in the disaster. Recent innovations not only offer the opportunity to reproduce this information but also to provide social protections to the general population and act as citizen communication platforms. New platforms allow SMS information to be geo-referenced and mapped or automatically entered into a database which can be made publicly available and accessed at no cost by individuals, local institutions, the central government, or international organizations. For instance Ushahidi, a crowdsourced ICT mapping platform, received 80,000 SMS texts from individual mobile device users in the aftermath of the 2010 earthquake, messages were translated, geo-located, prioritized and then relayed to emergency responders which greatly facilitated the aid delivery process and coordinated relief efforts amongst disparate organizations. (Nelson & Sigal, 2011) Noula, a Haitian equivalent to NYC's '311' or the "gate of crisis management" allowed various agencies to quickly dispatch supplies and medical assistance in a

more coordinated manor given open information flows. In the aftermath of crises, this spatial overlay also helps researchers to understand the causes and implications of such events. Such technologies can augment the capacities of the Haitian state to create spatial information, manage information, coordinate different activities and respond more adequately in emergency situations.

Large-scale investments that have taken place in the ICT sector for infrastructure improvements have granted access to a larger proportion of Haiti's population to exchange information instantly, highlighting the potential of these new platforms to facilitate information sharing amongst planning agencies in Haiti. Since many humanitarian responders have reacted by building their own private information databases, an uncoordinated approach has developed in which vertical information silos are created amongst both public and private entities. This severely limits access to information and contributes to duplication of efforts, and can be widely observed in Haiti amongst different governmental bureaus and NGOs. Use of such proprietary systems requires specialized training to access information, creating barriers to information and data sharing and limiting the abilities of state entities to make adaptations to the software. A dependency on external information sources or technical support has resulted. Newly developed platforms using Opensource Software (OSS) circumvent these issues by allowing for greater interoperability between systems and formats, increasing the ability to share data and communicate. OSS licensing also allows the source codes of the software to be available for public display, meaning amateur developers can build off of the source code, allowing for increased adaptations and derivations of existing technologies.

Shifting focus towards long-term sustainability, as governmental bureaus and firms begin to modernize their communications and data management, it becomes critical plan for this emerging market. The rapid technological change that has taken place in Haiti since the 2010 earthquake provides the opportunity to bolster Haiti's technology and information markets, allowing it to compete in the global knowledge-based economy. However, current institutional frameworks are impeding upon innovation processes amongst Haiti's technology community. The Government of Haiti (GOH) has engaged in multiple international intellectual property (IP) protection agreements which impose strict regulations for

imitating foreign software's, while domestic IP policy has lagged far behind the technological change discouraging local innovations. This concept will be further discussed in the

Failed States

"Haiti has become a failed state" (Schwartz, 2010). This has become a recurrent theme in most of the literature surrounding Haitian politics, both pre and post-earthquake era. In Schwartz's case, he posits this commonly perceived 'fact' to "fraud, greed, corruption, and political agendas that permeate the industry of foreign aid" and of, "disastrous effects of economic engineering by foreign governments and international aid organizations." (Schwartz, 2010). Although the scale of the January 2010 earthquake was quite large by international standards, the loss and damage triggered by the event was extremely disproportionate when compared to events of similar scale in different locales. Disasters pose significant challenges and threats to nation-states of any capacity - weaknesses in the US Government response to Hurricane Katrina were exposed in the aftermath of the event – but Haiti's latest disaster was magnified by the "pathologies of Haitian politics" and failed state which could not adequately respond to the event (Gros 2011;134). Haiti lost the majority of its personnel in the span of one business day, this dramatic and sudden loss of human agency has exasperated its already debilitated conditions. In addition to loss of human resources, Haiti lost the majority of its information archives – most of these being paper based and thus lost in the disaster. Because of this, in order to really understand in what capacity the state was functioning, serving its constituents, and responding to natural hazards, it is more valuable to look at governance in pre-earthquake Haiti. As Bilgin sums up this approach, "by historicizing various representations of 'failed states' it becomes possible to open up critical ways of thinking about the political economy of security and to consider alternative futures in world order" (Bilgin, 2002:55).

Foreign developmental practice has pervaded Haitian planning institutions; intervening organizations with inherent "self-organizing" and "self-evaluating" structures make the coordination and monitoring of these disparate groups extremely complicated (Schwartz, 2008). Moreover, scholars seem to be in accordance that an increased dependency on foreign aid, and the broader neoliberal economy, has

undermined Haitian governmental capacity through competition for human capital and resources with NGOs. This in effect has also limited its ability to oversee and manage these external forces (Pierre-Louis, 2011). The result has been a gaping void in terms of oversight and the erosion of the Keynesian social welfare state, leaving foreign intervention to fill the void.

What has been more heavily contested is how this state of dependency came to exist; some attribute the increased involvement of the global sector in state activities as a result of internationally perceived governmental corruption and dysfunction. Historical critiques have been centered on cultural practices and governance structures inherited from colonizing powers, resulting in authoritarian regimes and an elite class that have perpetuated patterns of inequality and oppression (Fatton, 2011). A slightly more nuanced version of this blames racism and cultural biases of the West and exploitative tendencies of Capitalism (Bellegarde-Smith). Isolating the Haitian state from the international realm, it becomes evident that internal politics of uncertainty play at least some role in the debility of the state. According to Jean-Germain Gros, the unwillingness of national Haitian leaders to devolve power stems from the fear of losing control in the process leading them to allocate services only as far as they can personally monitor. Severe fiscal restraints also limit public investment to where short-term returns will be the highest and where the most powerful constituencies are located, i.e. Port-au-Prince (Gros 2011;137-39). Inequities in distribution of resources between the epicenter of the country and the rest of the "country" have been the outcome.

Perhaps a combination of the aforementioned causalities of the dependent state, it is clear that perceptions of political corruption have resulted in foreign donors circumventing the state to deliver aid, one can observe a shift of decision-making power "up" to international aid organizations and "down" NGO's as a direct result of neoliberal globalization, resulting in a problematic "privatization" of service delivery (Schuller, 2009). These critiques articulate a nation where development is occurring haphazardly and externally to any comprehensive plan directed towards a particular vision. Disjointed development coupled with governmental inability to set parameters or coping mechanisms in place leads us to the question of vulnerability. "Haiti cannot respond adequately, if at all, to any natural disaster due to the

absence of any organization of the state that can quickly mobilize human and technical resources" (Gros 2011;. 149).

Adaptation Planning

In order to reduce vulnerability to recurring climate events, adaptation planning should be recognized as a necessary function of the state. According to one source, "adaptation means actions targeted at the vulnerable system in response to actual or expected climate stimuli with the objective of moderating harm from climate change or exploiting opportunities" (McCarthy, 2001). Here, vulnerability will be defined as human risk exposure to environmental hazard. It is important to understand vulnerability not just as a condition of the environment but of "socio-ecologies", or complex interactions of environmental and human systems (Beately, 2009). As a result of weak political and unstable economic systems that have led to extreme environmental degradation and poverty, Haiti has been identified as the most vulnerable SIDS. These conditions have further weakened its ability - at both the individual and collective levels - to recover from repeat shocks (Pelling and Uitto, 2011).

For SIDS such as Haiti, vulnerability reduction then becomes a key theme that can be categorized into three closely correlated concepts: resiliency, hazard mitigation, and sustainability. While mitigation has commonly been interpreted as physical intervention to reduce vulnerability to crises, resilience tends to emphasize the broader social systems and processes for facilitating response and recovery. These terms differ in resiliency's implicit "focus on creative adaptation and learning and its focus on developing an underlying capacity" (Beatley, 2009: 6). Thus, the scope of this research intends to contribute towards an understanding of "adaptive capacity" building in Haiti, specifically for regions outside Port-au-Prince.

Qualities of resilient communities vary, but such communities can broadly be recognized for their ability to continue providing goods and services that support quality of life while retaining basic structure, functions, and identity after being subjected to a variety of shocks (Walker and Salt, 2004). It then becomes important to ensure both the individual and the collective with faculty to reorganize at a local grassroots level to resist these forces, as well as to develop community institutions and networks for

supporting these functions. These strategies help build trust, enable learning, and assist the individual in the preparation and response to crises (Pelling, 2001; Beately, 2009). Drawing from Haiti-specific literature on the present day developmental landscape, it seems appropriate to advocate for an increased role of local government in organizing and coordinating future relief efforts as well as for steering long-term planning.

Decentralization and Participation

Another critique of the Haitian state centers around decentralization, here I will advocate that increasing citizen participation in planning processes is a necessary accompaniment to decentralization. After the departure of the authoritarian Duvalier regime from power in 1986, a "new", modernized Republic was formed and translated into the constitution of 1987. According to article 87.4, "Decentralization must be accompanied by the decentralization of services and by industrial departmentalization to the benefice of the departments" (Élie, 2009). Although the constitution sets the framework for autonomous local governances, applications of such decentralization have proven unsuccessful. Politics of uncertainty still plague the ruling elite class, as such, rulers tend to "personalize state power" which limits essential state services and assets to the primate city, drawing people from the hinterland to the city for basic services (Gross, 2011). These Haitian phenomena can help us understand the conditions in Haiti that led to such widespread destruction at the onset and in the aftermath of the January 2010 earthquake. Decentralization and participation are inexorably linked since localities could greatly increase leverage with national governmental agencies through identification and community needs and hard data, information that can be generated through avenues of public participation.

As Jane Jacobs puts it, "cities have the capability of providing something for everybody, only because, and only when, they are created by everybody" (Jacobs, 1961). The introduction of this idea - incorporating the disenfranchised individual into developmental processes to better serve the city in its entirety - was a pivotal point in planning discourse. Although the push towards decentralization has taken

many different forms over the past couple decades, it fundamentally advocates a restructuring of political space and an increased importance placed on the "local" (Mohan and Stokke, 2000). The idea of rescaling political power and decision making to a more localized level is an inevitable structural adjustment needed in Haiti. This however, can also be accompanied by major challenges and problems, such as lack of technical capacity to handle decision making at the local level and a downplaying of hegemonic politics at the local level. In the context of Haiti, which is already decentralized in terms of its development agencies but not in terms of political power, a more liberal interpretation of decentralization is required: one that recognizes a need for less reliance on external agents possessing normative biases to achieve locally determined change by the self and/or community for the self and/or community (Mohan and Stoke, 2000).

Albert Hirschman argues that consumers and members of private organizations drive recovery from lapses in performance, or "slack", by choosing between two distinct mechanisms: exit and voice. The voice option allows dissatisfied individuals to express opinions to invoke reform, while dissatisfied individuals who take the exit route simply leave the organization. Respectively, these mechanisms are political and economic reactions to slack (Hirschman, 1970). Applying Hirschman's ideas to the state, as an entity that also provides services to its members, or "constituents", one observes the need for both mechanisms in place to minimize slack and allow for constant recuperation. Given the frequent political instability and perceived "rigged" elections, one can denote that Haitians have not had consistent access to the voice option. Thusly, those with adequate resources have resorted to the exit option; effectively leaving the country for other countries that offer more/better services and opportunities for advancement. This trend has contributed to the "brain drain" phenomenon that has had profound ramifications on human capital in Haiti. Along the same ideology as Hirschman, Kenneth Arrow has noted that "when the market fails to achieve an optimal state, society will, to some extent at least, recognize the gap, and nonmarket social institutions will arise attempting to bridge it" (Arrow, 1963:53). Haitians without either voice or exit options have remained powerless, while civil society (NGOs and international organizations) has filled in the gaps for the state, a system that I have herein described as problematic. Voice provides

information to organizations, communicating feedback that offers solutions for improvement and change. My critique asserts that Haitian citizens, as constituents of the Haitian state, should be endowed with voice to effectively respond to the failure of the state.

Information Communications Technology (ICT)

Web 2.0 enables the "crowd", or the collective, to communicate volunteered information about needs, opinions, and/or location to a "cloud", a crowd, or an individual. The Web 2.0 phenomenon is often referred to as crowd sourcing, but peer production and cloud collaboration are other common terminologies (Zook et al., 2010:13). In countries with limited internet access, users of Web 2.0 communicate this information primarily through SMS messaging with mobile or cellular devices. This increased availability of information and spatial data has revolutionized the production of geographic information, which previously was restricted to professional cartographers. Applications of crowd-sourced information are constantly expanding beyond geospatial data production as new socio-technologic interfaces are configured.[2]

Innovations in ICT emerged during the humanitarian response to the 2010 earthquake in Port-au-Prince. Since geographic data can be produced more efficiently using these technologies, the limited technical resources were available for more imperative aid-delivery functions rather than for information production. SMS-based applications allow for new innovative processes of monitoring and data collection, changing the way decision makers approach service delivery (Berg & Modi). Perhaps more critical to the aid delivery process was the individual's ability to instantly report local conditions via SMS texting. Mobile devices provide citizens with an opportunity to express opinions and needs, effectively providing them with voice and increasing the potential to reincorporate the disenfranchised individual into the decision-making and planning process, filling crucial connectivity gaps. New technology platforms have acted as venues for communities to demand services, which has played a critical role for

[2] Current categories of recent and mobile ICT interfaces include: mapping, medical/health, governance, business/finance, water, traffic, information dissemination, informal work force, service delivery feedback and disaster management (Inclusive Cities).

disaster response coordination and delivery of aid (Shklovski et al, 2008). International actors have recognized the potential of such venues to inform long-term reconstruction planning processes and to act as facilitators of improvements in the quality of municipal level work and services.

A paper from Aalborg University coins the term "e-planning" as opposed to e-governance, which encompasses the use of ICT by local governments as a way to involve the community in a more efficient manner (Larsen, 2003). To avoid problematic interpretations of community participation, it is necessary to clarify the community in question as well as the degree of participation and power consigned to said community. Because this study analyzes the flows of communication that collapse space and time, participation will be defined as the empowerment of the individual citizen with voice. Within Arnstein's ladder, a theoretical model ranking the varying degrees of public participation, this falls onto the 'informing' rung (Union, 2005).

Given the current process, wherein local municipalities assess community need and relay this information to the departmental (regional) level where development projects are supposedly implemented, the SMS presents a unique opportunity to fill this void in capacity and resources. The incorporation of ICT into local, and potentially regional, planning practices has the capacity to allow for better coping mechanisms and thusly, decreased threats from future mega-events. A 2010 Master's thesis from LSE Cities Program entitled, "Crowd-Sourced Port-au-Prince? The possibility of SMS messaging in Re-building Haiti's Capital" proposes a theoretical model for using crowd-sourced mediums for redesigning the capital city in a more democratic process, incorporating critical input of the community (White A. , 2010).

However, these optimistic hopes for crowd-sourced technologies to empower disenfranchised groups are not without problematic assumptions. There remains a gap between the aforementioned conceived possibilities of ICT and its actual implementation. Most notably is the inability to authenticate and manage information, with no system in place to validate incoming data, one is forced to rely on the assumption that additional information communicated will correct the errors of invalid information, thereby decreasing the margin of error (Zook et al. 2010). This in turn discredits the information

generated from these technologies, because data was sourced from the crowd, it may have no bearing in local or regional, and certainly not national, decision making. Devaluation of crowd-sourced data may prevent its incorporation in decision making beyond emergency situations.

Additionally, there exist inequalities in knowledge and access to ICT, such as generational skills and rural disadvantage, which could result in small homogeneous groups representing a supposed "broad collective". Because younger generations are more adept at using newer technologies and adapting to innovations within them, this suggests that younger populations participate more in these processes and thus relying on these technologies as a means to generate public participation would exclude older generations. Even though it is assumed by the international community that mobile devices are ubiquitous, as of 2010, 3.5 million Haitians owned a cell phone, representing only 35% of the Haitian population (Boute, 2010). Barriers to access in technologies challenge the assumption that crowd-sourced technologies have a greater capacity to address diversity within communities.

Aggregates of information also prevent accurate and fair representation. Information communicated to a receiving platform is interpreted and prioritized, this subjects information to interpretative biases and if there are multiple operators, lack of standardization. For instance, a particular group of citizens could organize and text information about an issue within a community, while an individual who sends an SMS about a more imminent issue will be prioritized behind the group who is advocating for a more mundane and less pressing issue. Although this can happen with person-to-person participation, it is more difficult to understand the situation when the interpreter is not positioned on the ground (White A. , 2011). This would necessitate that localities be the managers of this data, however, local governments might not possess the technical or human faculty for processing and managing this data.

Additionally, current configurations of crowd-sourced technologies only allow for one-way flows of information, meaning data is communicated but often not responded to. Without closed-circuits of information flow there is no mechanism for accountability on the receiving end. This again calls into

question whether or not community input is actually utilized or incorporated within the decision making process. A new model would need to be developed to allow for a built-in accountability apparatus.

Although these technologies might have proved effective during the emergency relief process, it remains unknown whether these technologies can be harnessed and incorporated into a rebuilding and resiliency planning process led by Haitian public organizations. These technologies might perhaps be too complex to be centrally managed and don't truly engage citizen participation.

Technological Innovation and Emerging Economies

In the past, technological advancement, which intrinsically accompanies the process of industrialization, has been recognized for its economic development potential since modernization of technologies is closely tied with increased efficiencies in resource production. Innovations are drivers of technological change and can be typically classified in five ways: new products, new methods of production or processes, creation of new markets, new sources of supply, or new organization of competitive structure (Schumpeter, 1938). Technological innovations, though commonly linked with increased market efficiency, can also provide social protections if promoted through public policy (Srinivas S. , 2011). Adapting policies to technological change thus becomes critical in order to ensure that social protections coincide with innovation and economic expansion. Failure to do so may lead to income inequality, social stratification, or urban crowding since urbanization issues are closely related to technological choices, which often affect sectoral development and employment in rural versus urban areas (Eckhaus, 1977). Ensuring that policy is current with technological change is critical for maximizing social benefits from this advancement since there is often significant lag time.

As Srinivas and Sutz discuss, the dominance of innovations originating in industrialized countries are perceived to have certain universal characteristics and are associated with input resources that are available in abundance contexts. In this sense, globalization and international markets have contributed to the homogenization of technology; introducing new technologies that are not always appropriate for a given place when considering the constraints on available inputs and regulatory environments (Srinivas &

Sutz, 2008). Since late-industrializing countries operate in scarcity conditions with insufficient resources to replicate goods or technologies in ways that advanced industrialized countries are able to, this leads to innovations in both process and design when attempting to overcome these scarcities:

> "Any process of development must be supported by local strengths in knowledge and innovation…. to put [capacity to innovate in scarcity conditions] to work, the productive and social demands that need idiosyncratic approaches must be detected and translated into innovative terms: this is something that will hardly occur without purposeful actions, that is, a set of quite precise and focused innovation policies." (137).

Current institutional organization in Haiti has resulted in parties from advanced industrialized economies introducing technologies that are created with inputs and resources available in "abundant ambiances" into an environment of scarcity.

With this framework, one must denote the fundamental differences between technologies that 'increase resource productivity' and information and communication technologies (ICTs), which do not directly result in an increased capacity to create physical outputs but do affect the social modernization, and flows of information, which impact political processes. ICTs have accelerated the development of the intellectual capital market, one in which a knowledge-based global economy has emerged. It is important also to differentiate between social innovation – those which are derived and born out of some social need – and business innovations – those created primarily for generating profit (Mulgan, 2006). While many social innovations lack the financial models needed to be self-sustained, which prevents the private sector from operating and scaling such services, the public sector holds potential for operating and scaling such innovations. For the purpose of this study, both types of innovations will be examined. However, to more narrowly define the scope of this study, innovations in information and communication technology (ICT) that contribute to the generation of information that possesses utility to the Government of Haiti (GOH) will be examined. Since a confluence of new ICTs has surfaced in Haiti since the January 2010 event, one could focus on any specific sector: ICT for agriculture, mobile banking, mobile health, etc. Case studies featured in this research will examine innovations in ICT that generate geo-spatial information, a basic fundamental need for long-term planning.

Open Source Software (OSS)

Open-source software (OSS) are non-proprietary technology platforms which can include operating systems, PC hardware, game consoles, etc; these platforms are used for running various complementary applications typically provided by other competitive firms (Economides & Katsamakas, 2006). As a fundamental and assumed subset of new mobile ICT applications, OSS will also be assessed in this study since OSS have also been hyped for their ability to create derivative applications and promote innovation by lowering barriers to entry. OSS are considered to be information - or knowledge - goods that eliminate access costs and fees to both end-users and complementary competitive firms. In effect, because the cost of reproducing an already existing work is very low, additional agents may be introduced at near zero cost, lending to a larger variety of applications. Economides and Katsamakas imply that the zero price feature lends to a higher adoption rate and an increased willingness to pay for complementary applications, which results in a larger number of applications. Additionally they found that in a context where users prefer a larger variety of applications and when demand for the application is stronger than that of the platform, that open source industry will be more profitable than that of the whole proprietary industry (2006). This lends to the creation of additional works that build upon previous works, ultimately lending to a greater social benefit and greater variety. Another work shows how monopolies weaken incentives for independent innovation in integrated market systems[3] by extracting rents from independent suppliers (Farrell & Katz, 2000). Von Hippel asserts that open source platforms are contributing towards the democratization of innovation, ultimately allowing both users of platforms to innovate for themselves and circumventing the dependence on manufacturers who function as agents that deliver imperfect goods (von Hippel, 2005).

Although existing literature examines the impact of intellectual property rights (IPR) and proprietary software's impact on innovation, the question of proprietary versus open source platforms in industrializing countries is under-researched. Camara and Fonseca state that open systems will allow

[3] Integrated market systems are systems where the final good is a combination of two complementary goods, one which is monopolized and the other is supplied competitively; this can be applied to the technology platform – application market.

developing countries to adapt foreign technology to local conditions and will help embed indigenous knowledge in foreign technologies, helping to span between the two. Here, they advocate for policies that facilitate the emergence of technological innovations with low potential of reverse engineering but high potential for distributed development[4] through public investment in human capital (Camara & Fonseca, 2007). This work also cites the academic community as a vital component of open source contributions/production and thus, innovation. A working paper by Kogut and Metiu recognizes information as a public good[5] that can be distributed more effectively to developing countries through OSS, allowing for broader geographic participation in frontier innovation and avoidance of inefficiencies in IPR regimes (Kogut & Metiu, 2001).

However, because there are no intellectual property protections associated with open source software to exclude competitors and control rent, this has been argued to result in a loss of productivity for society with no incentive to create new goods. This might be true in advanced industrialized countries with strong states and enforcement capabilities, but is less so in industrializing countries with weak or failed states and no intellectual property protection regimes. Operating under open source licenses actually offers many advantages to overcome this obstacle, enforcing excludability and preventing free riding and theft. Through this means, many firms bundle immaterial goods with material goods, essentially commodifying intellectual property (Granstrand, 2000).

One study has concluded that innovations would continue to appear in the absence of patent protection and that in general, patents were not sufficient to appropriate or capture all benefits from innovation (Granstand, 2005). Economides and Katsamakas assert that "proprietary applications of an industry based on an open source platform may be more profitable than the total profits of a proprietary platform industry" leading to increased variety of applications with open source platforms (Economides & Katsamakas, 2006). This is an important point, this paper willl argue that the incentives and driving

[4] Camara and Fonseca define innovations with low shared conceptualization and high modularity as those that are not easily replicated through reverse engineering and which have higher potential for distributed development. These usually take place in academic spaces or through collaborations of software engineer networks (2007).
[5] Information can be defined as a public good since it can be replicated at zero marginal cost and is not mutually exclusive.

force of innovation for new information and technology platforms in Haiti was for the creation of social goods, even amongst the private sector. It will also be argued that open source software lends to a greater social good especially in industrializing countries where resources are scarce, thus barriers to access goods are high which restricts innovation and modifications to existing technologies. I will also assert that open source technology platforms encourage innovation by decreasing the risk of investment (high up-front costs, free riding, and low excludability) and through enabling free access to source code from which individuals or organizations are able to create new derivations.

DESIGN

The broad issue herein discussed has dealt with the connections between recent innovations in ICT, and adaptive capacity building within the context of Haiti. In order to effectively respond to my prompt question, I find it vital to understand the efficacies and limitations of different applications of new SMS-based ICTs before I can assess the feasibility for incorporating these technologies into the governmental framework. Although I initially intended to locate my study area in province (i.e. outside of Port au Prince) in light of the emphasis placed on decentralization, after conducting an initial site visit, I found these technologies to be irrelevant in such areas. This led me to focus on technologies being leveraged in Port au Prince, which is a strong indicator that they are primarily being used for reconstruction and relief efforts.

Phase 1. Inventory of Actors and ICT Usage

1.1 Inventory: Baseline conditions

In order to acquire an accurate understanding of the landscape on the ground, I mapped the different developmental agencies at work in Haiti in the ICT sector. To accomplish this, I began by taking an inventory of actors, and identified whether or not crowd-sourced technologies or data was utilized in each actors planning processes or was encouraged through their programs. If the former, I denoted the venue that data was derived from to also establish an inventory of ICT platforms within my study area. This

provided me with a launching point from which I then selected key cases of ICT usage to critically analyze.

1.2 Document Review

I explored various budgets and plans to quantify how innovations and information and communication technologies are being encouraged in Haiti and to better understand the policy framework behind the use of these technologies. This includes a review of relevant legislation on intellectual property rights (IPR), which will be necessary to provide a context for my understanding of institutional uptake of technologies. I also conducted a periodical review to inform my understanding of infrastructure development projects, and more recent innovations in ICT. To better comprehend the relationship between international intellectual property (IP) related agreements, domestic IP related agreements, and domestic innovation, I also ran rudimentary regressions to graph the relationship between these factors.

1.3 Mapping: Democratic or informative?

As an intermediary between this phase of research and the subsequent "critical analysis" phase, I also diagrammatically mapped information flows from ICT end-users through individual crowd-sourced data platforms (i.e. Ushahidi, Noula, OSM) over snap shots of time to understand evolution and adaptations of technology systems compounded with information flows of responding actors. This also helped me to understand how many applications have developed surrounding each platform. With this information I was able to draw conclusions about software nature (OSS vs. proprietary) and foreign vs. locally derived innovations. This analysis of communication flows allowed me to determine which platforms had the greatest amount of derivation applications, which had the most amount of uptake by state bodies and local or foreign actors, and whether the platforms were primarily one-way - indicating "informative participation" - or whether they were closed flows - indicating democratic participation in which there dialogue is occurring.

1.3 Interviews: Biased Interpretation?

I also interviewed various ICT platform operators that have been involved in Haiti (Ushahidi, Noula, etc.) to understand their interpretation and prioritization processes and how they perceive their role in disaster response, long-term planning, and facilitating community participation. Ultimately this allowed me assess whether there is bias in the way information is interpreted and prioritized. Since I am also focusing on mobile communication technologies, I found it relevant to conduct interviews with large-scale Haitian cellular providers (i.e. Digicel and Voila) since reception coverage is an integral component of communicating information, this helped to questions concerning accessibility. A further in-depth analysis of intra-organizational adaptation to innovations in ICT occurs in the next phase.

**See Appendix B for sample interview questions*

Phase II. Critical Analysis of Crowd-Source Technology

2.1 Interviews: Agency Analysis

This was the most critical phase of my research. I assessed whether new ICTs are effective at addressing the fundamental issues herein outlined, and whether they realize the perceived benefits. My institutional landscape map helped me to determine which actors are engaging in mobile SMS-based information production. From my inventory I selected three key cases that have engaged ICTs as a primary strategy to study at a deeper level. To triangulate my findings, the three case studies were selected to represent all sectors (public, private, and civil society). From here I conducted interviews with key stakeholders. Within each agency, I interviewed members and decision-makers to understand the software used, the innovation processes, technological evolution and outcomes and their associated perceptions. Although I had initially planned to survey beneficiaries to garner feedback, logistical constraints prevented this, in its stead; reports from the Red Cross and Internews were used to understand community reactions.

**See appendix B for sample interview questions*

Phase III. Planning Institution Response to Innovation

3.1 Interviews: Organizational Adaptation

During this portion, I engaged in a study of planning institutions in Haiti to understand how methodologies have changed to respond to and incorporate new data. I internally evaluated the role that ICT plays in informing agency activities and plans and how institutions have been reconfigured in response. This step was necessary to grasp the value that agencies assign to new technologies and if they are able to change, reorganize or restructure based on input received from the masses. This helped answer the question of whether ICTs can really be viable means to enhance institutional capacity, and if not, which impediments to this ideal could be uncovered. This required a series of interviews with representatives regional governmental bureaus such as FAES, Regional Ministry of Planning, DINEPA and community-based organization, as well as local governmental representatives (mayors and CASEC members). One national representative was also interviewed. Through this segment, I sought to understand how many resources were consumed during the conversion process to gauge the feasibility of incorporating new ICT into governmental planning processes.

**See appendix B for sample interview questions*

Given that the public sector has largely been bypassed by foreign entities in planning and development processes in Haiti, with no coordination or overarching long-term plan aligning the foreign agendas imposed upon localities, it seems viable to take a stance that the state should play an increased role in this process. The critical questions to answer were how has the state benefits from these technologies and in what ways have these new platforms augmented the capacity of the state to plan for resiliency? To do this, aside from taking an inventory of new media platforms and mash-ups introduced immediately after the onset of the earthquake, it was necessary to assess which of these have provided direct benefits to state departments or organizations. Additionally, of the apps with the most widespread impact, how are they faring today? In what way have they been adapted or localized to better suit Haitian capacities? These questions will be answered in the next portion.

Findings:

From analyzing the three case studies, ongoing plans for integrating ICT into planning activities, and the legislative framework for innovations and intellectual property rights in Haiti, it is clear that new ICTs have the potential to increase adaptive capacities of governing bodies but that there are major limitations to this. Thusfar, institutionalization of new ICTs in Haiti has happened only on a surface level. I present the following observations:

- ICTs possess the potential to address citizen needs, create accountability and transparency mechanisms, but this very feature also creates barriers to institutionalization due to increased risk for participating organizations. State entities might be reluctant to adopt such platforms due to fears of accountability and responsibility when capacity to act on certain information is low.

- Modernization of ICTs in governing bodies could also enhance efficiencies in information management and enhance communication and information sharing between sectors but this is constricted by the maintenance of such platforms, for which local organizations remain dependent on foreign entities to operate and modify such systems – these systems become more static by default.

- Locally developed platforms have a greater number of offshoot applications and partnerships than those developed by foreign organizations.

- Open source software hasn't resulted in a greater number of local applications due to high switching costs and path dependency.

- Scales matter: national level bureaus where infrastructure, resources and technical capacity are concentrated have greater uptake capacity in comparison to local levels where there are human and material resource deficits.

- Local innovations in ICT are increasingly taking form in mash-ups for social purposes, combining multiple forms of social media to reach a broader audience. End-users (i.e. the public) have latched on to such modes of communication with decision makers and the humanitarian community.

- ICTs do present valid potential to enhance efficiencies to plan and manage crises but are only tools and cannot effectively augment capacity in isolation – capacity building and supply-side tactics need to be considered.

- Uptake of varying projects and platforms is also highly dependent on the networks within which platforms and developers are functioning; government entities seem more willing to accept foreign-derived platforms since they appear to be more hi-tech rather than encouraging local idiosyncratic innovations. Also, since this means they receive money, they will be more likely to adopt foreign technologies. Existing connections mean more trust and confidence with certain providers and lack of trust with new providers.

- The utility of recent innovations in ICT in Haiti is not in the creation of transformational software or platforms but in the adaptations and different applications that stem from already existing software

- Haiti is engaged in many international IPR agreements but has outdated legislation on IPR protections, which drives up prices for foreign firms, lowers the quality of local technologies, and disencentivizes innovation.

Analysis

Landscape of New Media

As a preliminary assessment, I conducted a survey of the key players who facilitated the introduction of new information and communication technologies into the 2010 Haiti disaster response. The utility of these platforms and actors vary, from increasing the efficiency of information management to information sharing, and improving communications with disaster affected communities.

	SMS Broadcasts	**Mash-Ups**	**GeoTagging**	**Crowdsourcing**
General Description:	Cellular providers partnered with humanitarian organizations to distribute vital information to disaster-affected citizens using SMS blasts. An expensive yet effective method	The combination of existing media platforms to reach a broader range of audiences and to incorporate feedback mechanisms and two-way information flows.	This involves attaching geographic information using the coordinate system to different forms of media content, in the Haiti earthquake response this involved primarily the tagging of SMS messages or voice calls.	This process involves outsourcing of tasks to the public or an undefined/unknown mass of people known as the crowd.
Actors involved:	IFRC Voila: public health messages on relief services InSTEDD Emergency Info System Platform – Mission 4636: public health messages (26,000 subscribers) Digicel Public Minister of Health sent messages on cholera prevention	Internews Provided a humanitarian program to all radio stations, which reported on critical information and offered SMS call-in programs and open mics. Radio 1 Supplementing traditional forms of media, i.e. radio with new media such as Facebook, Twitter to search for missing persons Radio Tap Tap An application of Noula which recorded audio soap-operas to play in public transport to track public transport flows	C-OSM.HA Haitian OSM team that plotted locations of humanitarian services in the aftermath, and also verified information. Ushahidi Students at Tufts geotagged incoming SMS messages as well as from social media Unicef/DINEPA Employed field enumerators to send information on water testings in IDP camps via SMS messages containing the geographic coordinates	Ushahidi A US based crisis mapping platform that was in effect for the first few months after the earthquake to communicate needs to responders Noula Local crisis mapping platform and call center that developed many offshoots with various partners HOT Launched a public mapping platform to better assist responders in wayfinding

Figure 1.1: Chart of new Infocoms introduced in Haiti after January 2010 [Source: Knight Foundation Report, 2010]

Based on my preliminary survey of actors engaged in the leveraging of new information and communication technologies, I decided to limit my scope to applications that contribute to the production of geospatial information, as this was identified as a critical need for planning in my review of existing literature. I have identified three different platforms located in the private, public, and civil society sectors to detail in the following section: Noula, OpenStreetmap (OSM), and SIS-KLOR. The following chart provides a brief overview of the characteristics of each:

	Private: Noula	Civil: OSM	Public: SIS-KLOR
Open-source?		X	
Crowd-source?	X	X	
SMS-based?	X		X
Internet required?		X	
Public Information	X	X	

Figure 1.2: Characteristic and Case Study selection table

Access to Infocom Technology

General Population

Aside from scarcities of material and immaterial resources, place-specific idiosyncrasies may prevent well-developed technologies and/or platforms from being transferable to industrializing countries. I will outline a brief analysis of communication habits in Haiti and how they are transitioning with increasing exposure to ICTs and social media such as Facebook and Twitter. This outline should serve as context with which to situate the general population's attitudes towards the infocom platforms I will be detailing in my case studies.

The International Federation of Red Cross (IFRC) and Red Crescent Societies 'Beneficiary Communication Evaluation' surveyed 10 sites – both in internally displaced persons (IDP) camps and surrounding communities – which totaled 626 individuals. This study reveals the primary information sources amongst the surveyed population which overwhelmingly indicate a preference for face-to-face interactions. Whether between beneficiaries and employed community workers, or word of mouth

methods amongst the general communities, urban Haitians rely primarily on audio and oral communication to share information.

> "One friend of mine went away for two weeks; when she came back in the community she explained to me as her close friend that she had felt sick and she used the Ministry of Public Health hotline to find information and she went to a cholera treatment centre alone and followed the treatment."
>
> -Woman camp resident, Port au Prince

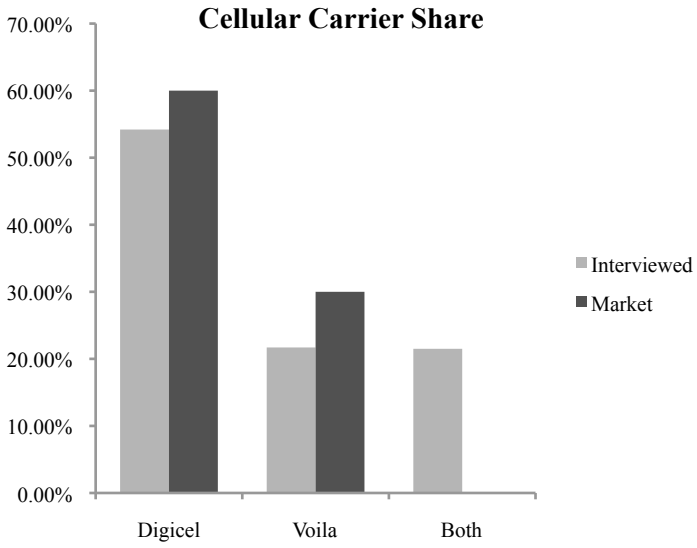
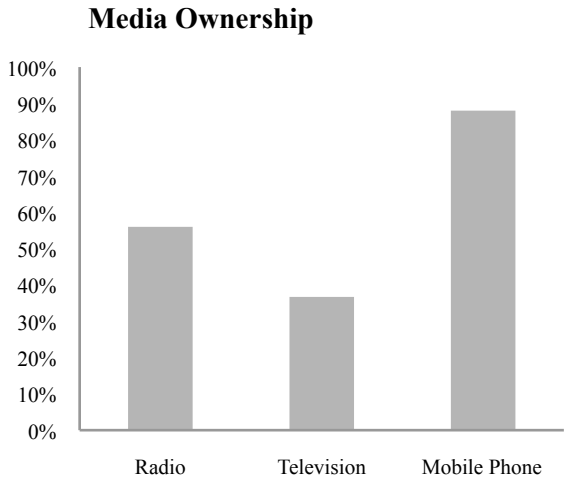


Fig 2.1: Market shares of the two primary cellular providers in Haiti – cross-referenced with the usership of cellular providers amongst the IFRC beneficiaries. [Source: IFRC Beneficiary Communications Evaluation, 2011]



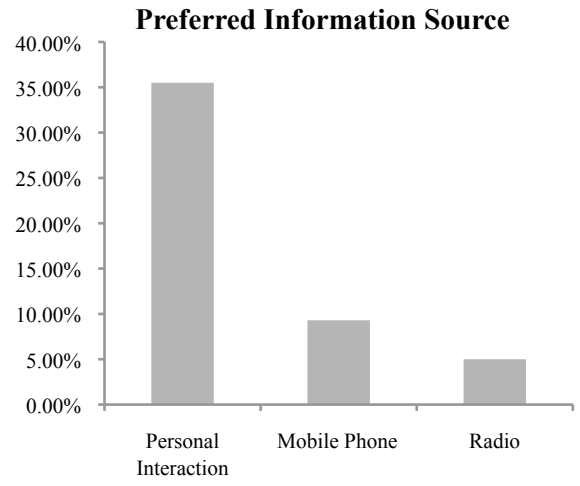


Fig 2.2: Ownership of various forms of media amongst beneficiaries. [Source: IFRC, 2011]
Fig 2.3: Preferred media for obtaining information amongst beneficiaries. [Source: IFRC, 2011]

Access amongst public planning bodies

If located in the capital, Port-au-Prince, public officials will generally have access to Internet and computers. However, from conducting interviews "in province" i.e. outside the capital, it is clear that public officials generally do not have access to the Internet depending on their level. For instance, communal governing bodies (i.e. at the municipal level) do not have access to computers or Internet, and will use their phones sparingly on account of expensive voice call and SMS rates. At the regional level, public officials do have access to laptop computers, but not internet. In the office I visited, only one staff member had an internet key. The regional staff and also use their phones sparingly on account of expensive calling and SMS rates; this geographic divide, between urban and rural and different scales of governance result in fragmentation and miscommunication between sectors and planning bodies. In one interview, a regional planning executive identified cross-sectoral communication as being one of the biggest challenges faced by the planning office (Charles, 2012).

However, within the past year, a new cellular provider, Natcom, has emerged replacing the older corrupt version, Telecom. Natcom is a Vietnamese company that is part GOH owned (40%), heavy subsidies on call rates and data plans mean that this will be aggressively cutting into market shares amongst other cellular providers and stimulating competition. Already this company has started pushing for wireless connection keys that can provide internet access based on 3g data networks, meaning you don't need to have a wireless connection. This presents huge opportunities for expanding internet access to outerlying provinces, since extending internet infrastructure was costly and often tampered with (Haiti Libre, 2011).

Geographic Divide

To understand the differences between urban and rural access, a map of cellular coverage was overlayed with population density from SEDAC, the socioeconomic data and applications center at the Earth Institute. The bright red areas show where urban populated areas exist without adequate network coverage. The intention of this map was to show the disparity between urban and rural network coverage, but the outcome demonstrates there are still densely populated areas without adequate coverage.

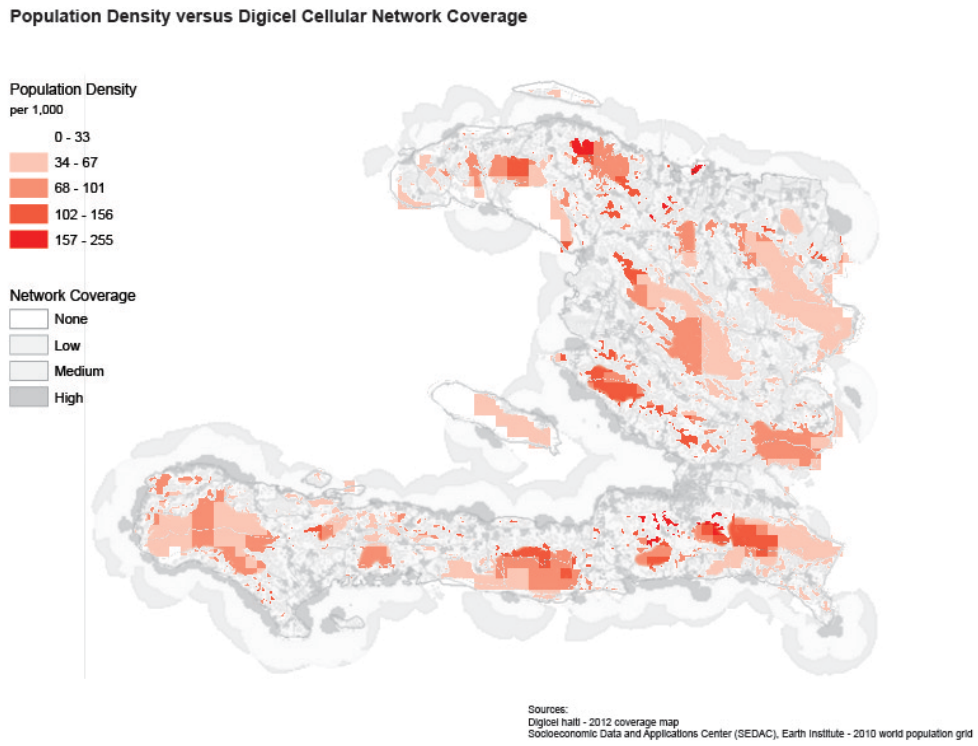


Fig 2.4 Urban areas without network Digicel coverage[6]

Institutional Framework

The following section is an analysis of current domestic policies, plans, and international agreements which affect technological innovation in Haiti. I will first look at the political importance placed on modernization of ICTs, the ongoing plans to promote the advancement of the ICT sector, and the intellectual property rights (IPR) regimes to illustrate the institutional environment within which the

[6] This is in juxtaposition to a press release from President Martelly that claims that Haiti has a 90% network coverage. It should be noted that although the map above only depicts Digicel's network, one of 3 major competitors, it is unlikely that the others extend much beyond the Digicel network.

modernization of ICTs is occurring. Ultimately, this section attempts to understand whether domestic technological innovation is being encouraged or whether existing foreign technologies are being used to modernize communications and information management within the state.

Political Agenda

Increasing public awareness of the rapidity of technological change and the slow pace at which the Haitian government has reacted and adapted to such change has led the prioritization of this sector on the national agenda. In an address by the President of Haiti in February 2011, Michel Martelly emphasized the importance of technological advancement as an underlyer of economic development. To promote this, he outlined three primary axes of intervention:

> " 1- The modernization of the state through the introduction of technological tools making the management of the state more effective and more efficient, while improving the quality of public services to citizens.
>
> 2- The creation of jobs and businesses in the ICT sector by encouraging local and foreign investments in order to diversify the economy and to stimulate innovation, particularly among young people, who constitute the majority of the population and represent the future of the country.
>
> 3- The modernization of the business environment and infrastructure, necessary for the emergence and the development of a true information society. " (Haiti Libre, 2011).

Although Martelly called out the importance of creating innovative enterprises in the ICT sector, no direct actions to achieve this were mentioned. Additionally, Martelly has not recognized the need for updating the current regulatory framework within which innovations and technologies must prosper. A review of periodicals relating to the technology in Haiti indicate a number of new domestic innovations that were designed with a rich understanding of the institutional needs in Haiti but that are constrained by outdated legislation. One example is a project designed by a team of students at the Ecole Superieure d'Infotronique d'Haiti (ESIH) who developed a program that encrypts and secures messages transmitted electronically, which will significantly improve communications between law firms, notaries, the Ministry of Justice and the National Press of Haiti, and will decrease delays in the electronic publication

of documents for the general population (Haiti Libre, 2011). However, the article mentions the infeasibility of this project due to legislative challenges such as lack of legal recognition of electronic signatures and absence of regulation for electronic commerce, indicating a failure of intellectual property rights (IPR) regimes that promote the uptake of such innovations.

Current ICT Policy

In 2005, a 'Bureau Haitien du Droit d'Auteur' (BHDA) was established to protect intellectual works, the rights of authors and the enforcement copyright laws. A decree was written simultaneously to coincide with this new body of copyright enforcement. Although this was an advancement towards increasing intellectual property protections, there was little reference to electronic intellectual property, with only two short subsets of one article addressing the matter - see appendix A for translated articles (World Intellectual Property Organization, 2010). New forms of property and capital require complex protection legislation which is not well formulated in this decree. Current policy is outdated and the regulatory framework to accompany technological advancement is weak. Until recently, the last regulatory text in relation to telecommunications was passed in 1977.

Against this backdrop, five laws regarding telecommunications, electronic signatures, electronic exchanges, and e-governance have been drafted and are waiting for ratification from the Prime Minister before it can be submitted to the parliament (Haiti Libre, 2011). However, this branch of the government has been unstable since the election of Martelly in 2010. The absence of such regulatory framework prevents the genuine uptake of ICT which poses massive barriers to the modernization of business and state functions.

Plans for promoting ICT uptake

The International Development Bank (IDB) launched two programs in 2011/2010 promoting new information and communication technologies to support institutional capacity building in the Government of Haiti (GOH). The aims of this initiative are to increase transparency and efficiency of information

sharing to promote "collaboration among all governmental entities and other participating partners, thereby establishing the conditions to strengthen GOH's institutional capacity in the long term" (International Development Bank, 2010). Such program calls for the establishment of an ICT task force 'Groupe de Travail sur les Technologies de l'Information et de la Communication' (GTIC) under the Prime Minister to identify and support training programs for capacity building. The program also calls for the establishment of the Haiti Integrated Government Platform (HIGP) open technology platform to provide capacity to host 'government information systems and databases, promoting efficiency, effectiveness and transparency and creating institutional capacity in the Haitian public sector' (International Development Bank, 2010). The budget for the project is $3,700,000 over a 24-month disbursement period, which is divided between IDB and Microsoft.

The plan calls for advancements in ICTs utilized by the GOH, but innovation is never mentioned as a strategy for advancement. A procurement strategy is described, however, the strategy dictates that Haiti award the contract for the development of the platform's architecture to a Microsoft appointed partner, Infusion. Microsoft has also donated licenses, so the Government is limited to a set list of providers (provided by Microsoft) that are compatible with these license agreements. Additionally, though the platform might achieve efficiencies in information management, the goal of improving communication of such information to citizens assumes that the majority of the population has secure access to Internet. Even if this assumption was correct, there is no feedback mechanism in place for which to generate feedback or input, thus resulting in only one-way streams of communication. There is no mention of utilizing capacities that already exist in Haiti in the private sector to build the platform for the state. A procurement strategy directed towards a domestic set of providers could spur local innovation and result in an end-product that is more suitable to the state. Additionally, contracting foreign providers and developers will leave the state dependent on international providers without the ability to make minor modifications or perform system maintenance independently. Once the terms of the grant are over (a mere 24 months), this could result in massive costs to the Haitian state to maintain an operational platform.

Intellectual Property Rights (IPR)

An understanding of the regulatory environments of iboth nternational and domestic of IPRs is critical to assess whether innovation in Haiti is being encouraged or discouraged. I will build off Chen and Puttitanum's (2005) theory that there exists a trade-off between the imitation of foreign technologies and domestic innovation:

> The foreign firm has a patented technology that allows it to produce a product of a higher quality than can be produced by the domestic firm. However, the domestic firm can raise its product quality by imitating the northern technology, and its ability to do so depends on the level of IPRs in this country. The local sector consists of two firms, one of which has the ability to develop a patentable new technology that improves the product quality, while the other local firm can imitate the new technology. Increased protection of IPRs makes imitation in both sectors more difficult, which has different effects on the country's welfare. In the import sector, less imitation means lower product quality of the domestic firm and thus less competition for and higher price of the foreign firm…In the local sector, less imitation means more incentive for the domestic innovating firm to invest in a higher-quality technology (more innovation), which leads to more efficient investment and to a higher social surplus.

Chen and Puttitanum argue that domestic innovation increases with enforcement of IPR, and enforcement of IPRs increase as economic development advances. However, strong international IPR regimes coupled with weak local IPR regimes will result in lower-quality goods and less innovation at the local level, and higher-quality goods and more innovation at the international level (Chen & Puttitanum, 2005).

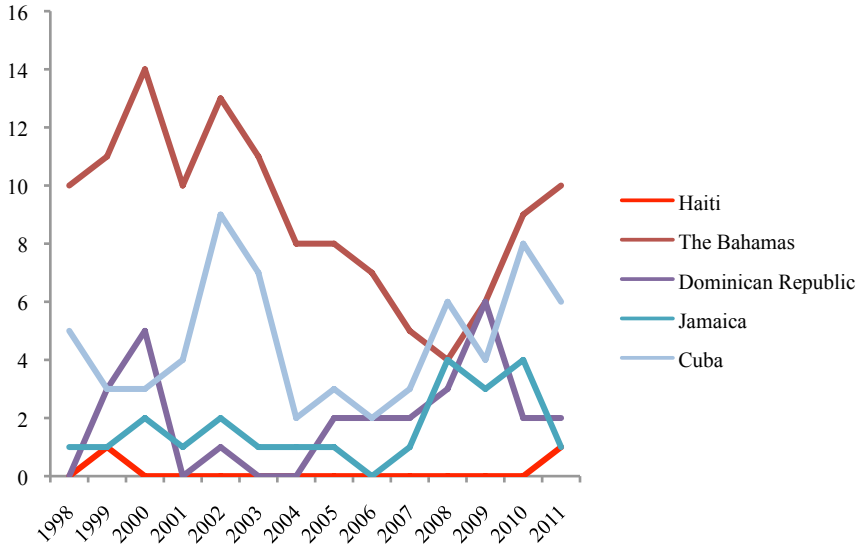
Archival research on IPR policy in Haiti has shown that domestic IPR protection is relatively weak compared with its high protection of international IPR (represented by its membership in international IP-related treaties). This perpetuates high prices of foreign technologies and reduces incentives for domestic firms to innovate; for example, the last text written on IP-related legislation dates from 1985. One article in the 'Criminal Code of Haiti' [see Appendix A] constitutes the penal framework for any counterfeiting of goods that infringes "intellectual property rights" (World Intellectual Property Organization), or "property of authors". However, there is no outright definition of intellectual property in this text and since these codes only deal with material property, i.e. productions or goods that

are "printed or engraved", it is debatable whether this can even be considered intellectual property.[7] Despite the lack of recognition or enforcement of IPRs domestically, Haiti is engaged in 6 international World Intellectual Property Organization (WIPO) administered treaties, 29 multilateral IP-related treaties, and 2 IP regional treaties [See Appendix for a complete list] (World Intellectual Property Organization). Memberships in so many international agreements constrict the ability of local firms to reverse engineer or imitate higher quality technologies available internationally, resulting in less competition for foreign firms and higher prices, and lagging local innovations.

Patents

In absence of nation-wide data available on innovation, I will use patents to illustrate the level of innovation occurring in Haiti. The number of patent applications will be used as an indicator for representing the number of innovations over the past decade in Haiti. The below graphs are meant to compare the levels of innovation in Haiti with those of neighboring countries in similar stages of economic development (Fig 3.1).

Patent applications in the Caribbean <1988 - 2011



[7] Intellectual property is commonly understood as "all non-material or intangible resources" Maskus, K. E. (2000). *Intellectual Property Rights in the Global Economy*. Washington DC: Institute for International Economics. to the extent that they "bear recognized ownership"Granstrand, O. (2000). The shift towards intellectual capitalism - the role of infocom technologies. *Research Policy* , 1061-1080..

Fig 3.1 Graph of patent applications per year in varying Caribbean countries[8][Source: US Patent and Trademark Office Patent Technology Monitoring Team (PTMT)].

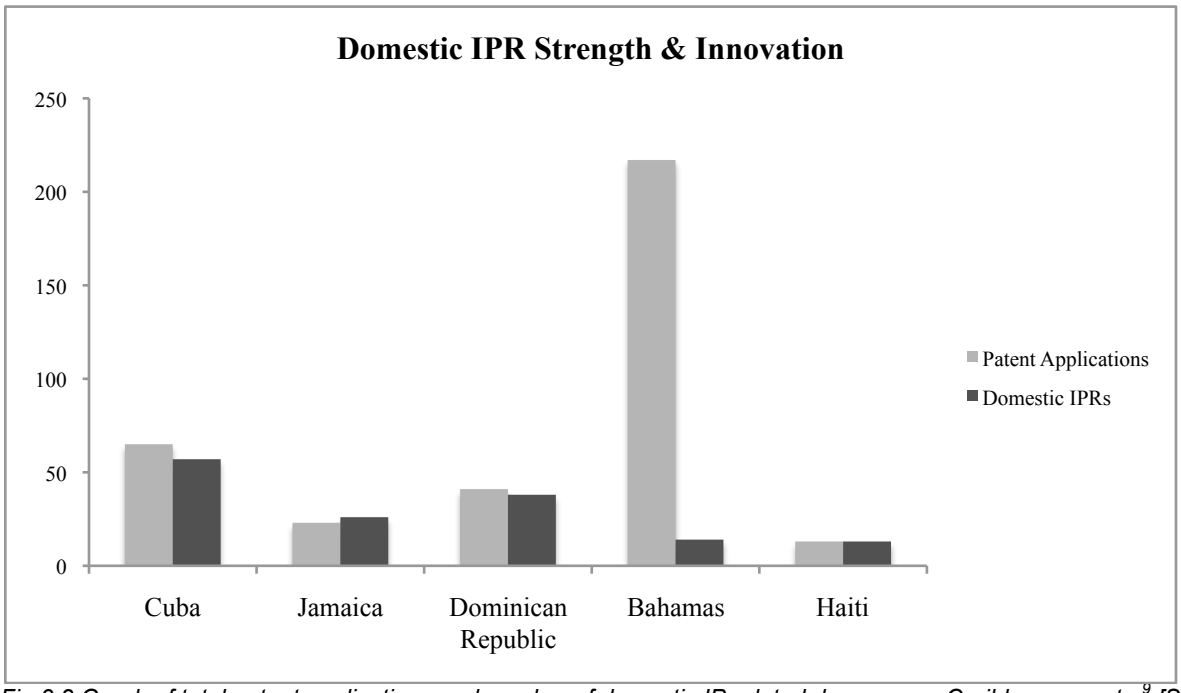


Fig 3.2 Graph of total patent applications and number of domestic IP related decrees per Caribbean country[9] [Source: US Patent and Trademark Office Patent Technology Monitoring Team (PTMT), World Intellectual Property Organization (WIPO)].

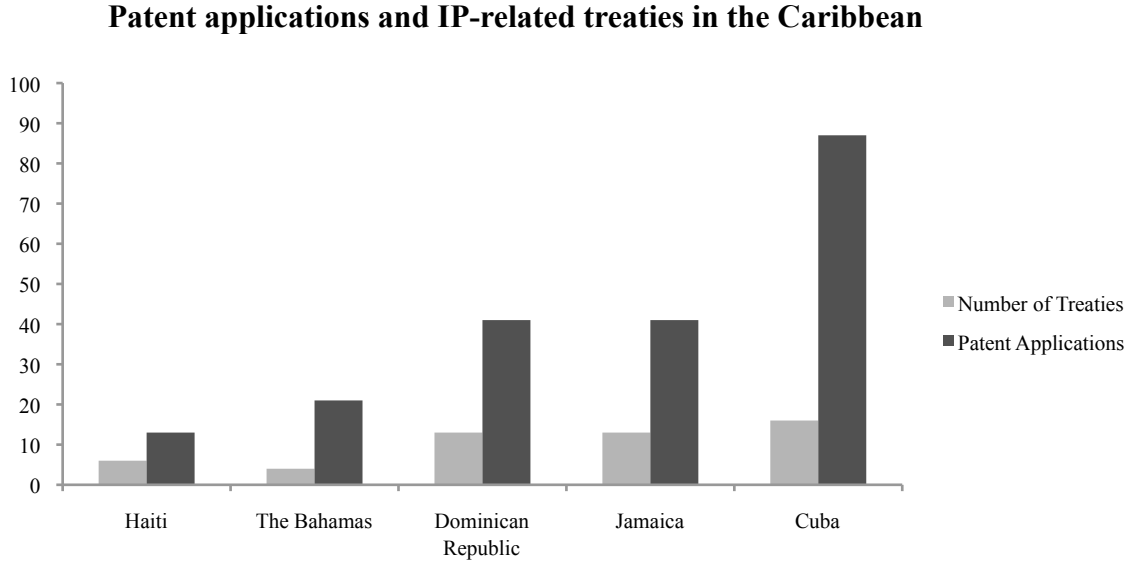


Fig 3.3 Chart of the aggregate number of patent applications in varying Caribbean countries[10] with available data, in relation to the number of WIPO, U N, and WTO IP-related treaties per country [Source: US Patent and Trademark Office; WIPO].

[8] There is no data available on patent applications in Haiti from the Ministry responsible for such applications, the Ministry of Trade and Industry.
[9] There is no data available on patent applications in Haiti from the Ministry responsible for such applications, the Ministry of Trade and Industry.

The above chart (Figure 2.1) indicates that Haiti is lagging behind in terms of patent applications compared to competing neighboring countries in its geographic region with only 2 patent applications from 1998-2011, although prior to 1998 there were 13 patent applications. Additionally, Figure 3.2 shows that with the exception of the Bahamas, there seems to be a correlation between the number of domestic IP-related decrees or policies and the number of patent applications. Figure 2.3 portrays the relationship between each country's memberships in international IP-related agreements and patent applications, which shows a more negative correlated relationship than patent applications to domestic IP policies. To further explore this relationship, I compared the number of international treaty memberships (exogenous IPR protections) in Haiti to the aggregate number of patent applications as indicators of innovation.

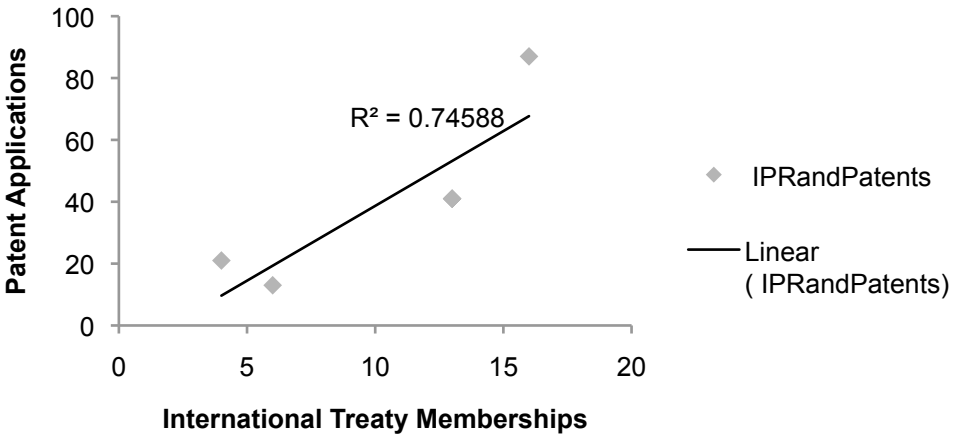


Fig 3.4 Impact of International IPR agreements on innovation in Haiti over time [Source: US Patent and Trademark

This comparison demonstrates that there is a positive relationship between the number of treaty memberships and number of patent applications. However, this does not demonstrate causality. To better understand the economic settings in each country and whether the level of economic development has an impact on either indicator, I compared the relationship between the current GDP of each country to its number of patent applications and treaty memberships.

[10] The countries displayed were selected based on availability of data, these are not representative of all countries in the Caribbean.

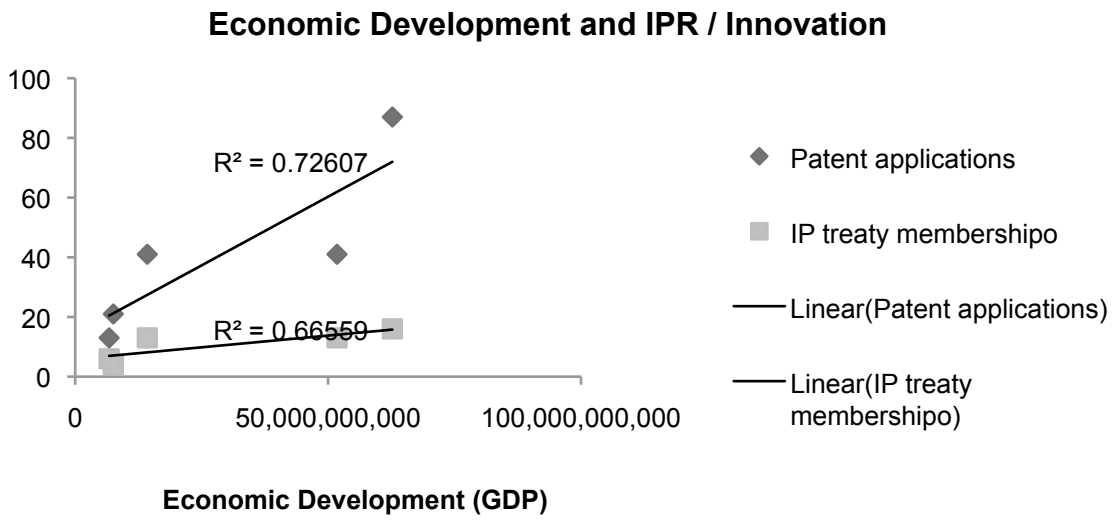


Fig 3.5 Impact of economic development on both innovation and international IP agreements [Source: US Patent and Trademark

Based on this rudimentary analysis, it appears that membership in international treaties has a more prominent correlation with number of patent applications ($r^2 = .746$) than economic development does ($r^2 = .726$). Additionally, there seems to be a less significant correlation between economic development and treaty memberships. This is indicative of the aforementioned relationship. However, Chen's text asserts that there is a critical juncture in economic development at which states will start enforcing stronger IPRs to promote domestic innovation. However, before this juncture it is advantageous to not enforce such protections to allow more imitation of foreign technologies.

This poses obstacles for modernization of businesses and state entities since there are no protections or security. Additionally, lack of intellectual property protections reduce incentive for domestic enterprises to innovate, since capital costs needed to invest in research and development are increasingly high (due to international regulations), yet the absence of domestic IPRs make imitation by competing domestic firms possible. Essentially resulting in a system where risk to innovate is high and opportunity to secure profit is minimal, thusly there is no incentive for domestic innovation.

My case studies will now examine different applications of ICTs and their efficacy of enhancing capacity of the state, here I will attempt to illustrate that domestic innovations have more utility as they

are more appropriate and scalable than foreign innovations. This will be critical to understand how to encourage more 'suitable' and 'appropriate' innovations in ICT in Haiti.

Case 1: Ushahidi Haiti Project and Noula

Ushahidi Haiti

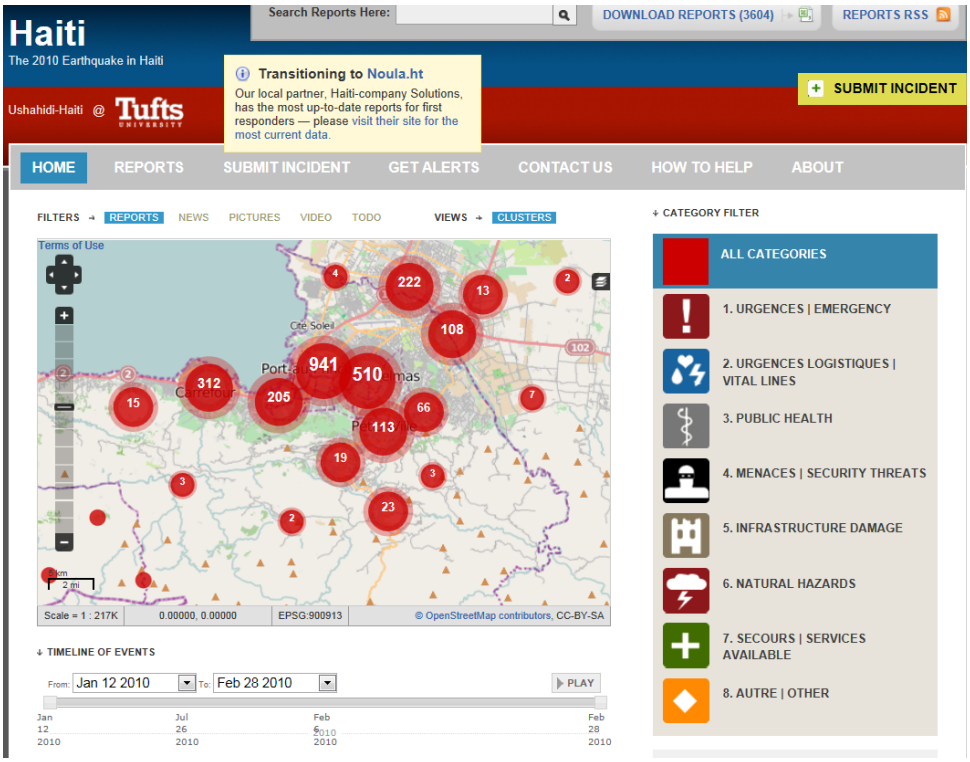


Fig 4.1: Ownership of various forms of media amongst beneficiaries. [Source: IFRC, 2011]

A group at Tufts University Fletcher initiated the Ushahidi-Haiti Project (UHP) immediately following the January 12, 2010 event. The goal was " to involve the citizens of Haiti in their own reconstruction by providing information and ways for local voices to be heard". The platform was live in a couple of days after the event. UHP was plugged into the larger *Mission 4636*, a collaborative initiative involving numerous humanitarian emergency responders such as the International Federation of Red Cross (IFRC), Internews, InSTEDD, Digicel, the State Department, etc. to coordinate and provide citizen engagements for the affected populations. The platform relays messages received via SMS from beneficiary and

disaster affected communities to critical humanitarian responders. However, although the Ushahidi team employed members of the Diaspora, there was no call center set up so messages could only be received via SMS, a major barrier to access given the low literacy rates and preference for person-to-person interaction in Haiti.

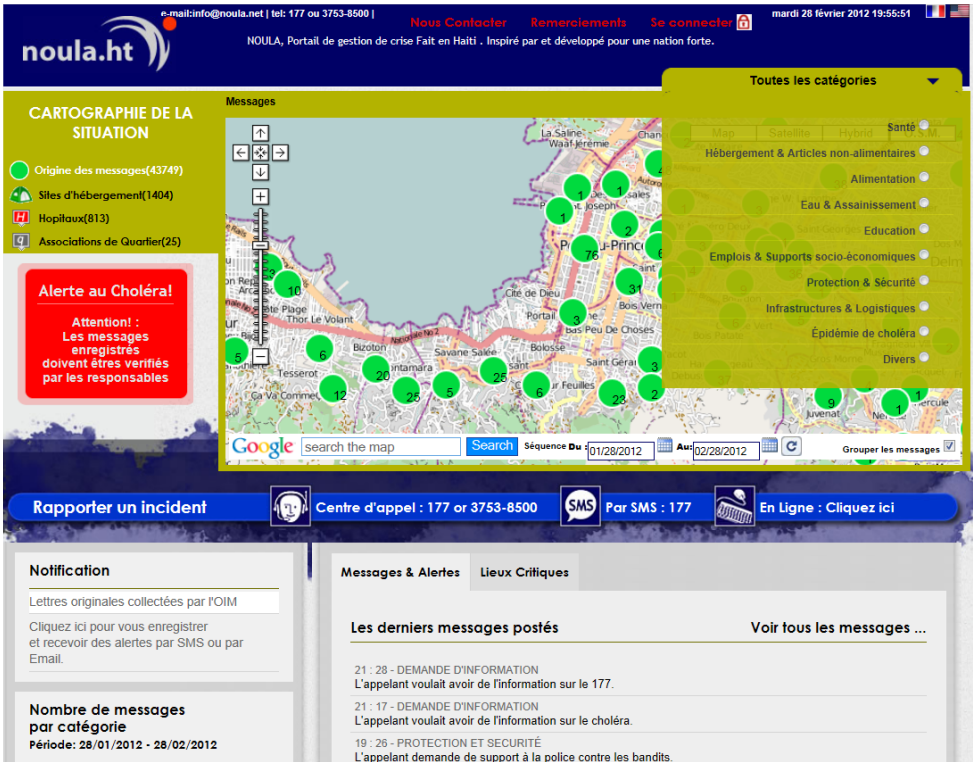


Fig 4.2 Noula.ht Interface

Noula

Noula is a not-for profit foundation that was founded by Solutions S.A., a private Haitian software development company. The Noula platform is similar in concept and implementation to that of Ushahidi Haiti, the use of crowdsourcing technologies to collect information from communities, plot out the incident on a global database/map, and relay the actionable information to an appropriate responder. Noula incorporates information received from various forms of media: to date 28,347 messages (including SMS messages and email) and 29,637 voice calls. The platform as a manager of the application was founded to gain traction amongst the traditional disaster response system after receiving

skepticism from the humanitarian community, suspicious of a private sector firm working in the humanitarian sphere. The concept of the platform is similar to that of Ushahidi Haiti, however the software was developed exclusively by Haitian developers affiliated with Solutions S.A.

Adaptation

UHP sent representatives down as soon as 10-days after the earthquake to assess the situation on the ground and to begin forming partnerships amongst humanitarian responders. The engagement between UHP and SOLUTIONS S.A. began informally in mid-February 2010 and more formally in April. UHP assisted with the planning and the design of the Noula platform but retained a strictly advisory role, meaning SOLUTIONS made all the decisions. In March 2010, Ushahidi offered Solutions the option to accept the Ushahidi platform but Noula ultimately chose to continue building up their own platform. The Ushahidi Haiti platform continued receiving messages via the 4636 short code[11] (formerly a weather reporting channel that was donated by Digicel) until June 2010. At this time, all technology infrastructure was in place on the Noula side and the new short code, 177, was deployed which routed all information to the Noula platform. UHP continued providing assistance to Noula in an advisory capacity until May 2010. This took place on three levels:

1. Technical Support – providing assistance to SOLUTIONS developers and speeding up the process.

[11] Short codes are special telephone numbers, shorter than regular numbers, used to direct SMS messages from cellular devices, i.e. 177 and 4636, both provided by Digicel. Arrangements for short codes are made with cellular providers and negotiations must be made, but other software can be used in stead.

2. Work force development – assisting with the human resource aspect of operating the Noula platform, this includes planning for how many staff members are needed as well as strategic thinking.
3. Networking – introducing and promoting Noula to the humanitarian community which was unaware of the local system for communicating and assessing community need, helping Noula to understand the log base issues and security settings (Valuch, 2012).

In August 2010 Ushahidi withdrew support and transferred the remainder of their funding to the Noula platform (about $4000) to purchase headsets, equipment, etc. Funding was also granted to a local radio station based in Cite Soleil, Radio Boucman. There was no support given after this time as Noula had been already been plugged in to the humanitarian network.

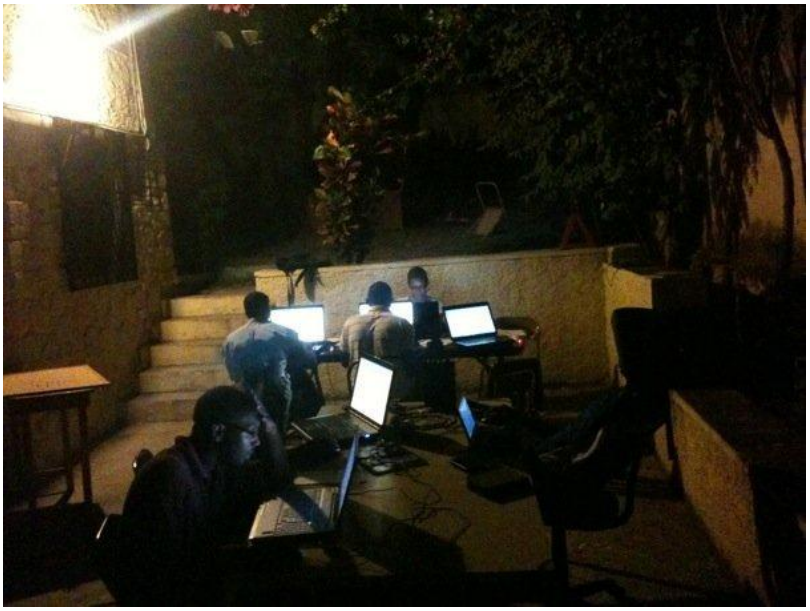


Fig 4.3: Image of developer team working in the weeks following the earthquake, clearly in scarce conditions [Source: Jean-Charles, K; 2010]

Noula's rejection of the Ushahidi platform is a significant point, an indicator that this platform was not suitable or adaptable to Noula's resources, specifically in terms of technical capacity. According

to Kurt Jean-Charles - the Noula founder - Solutions staff attempted to work with the Ushahidi platform (which uses .php scripting language) to adapt the platform to their vision and needs but in the end determined that developing their own platform from scratch would be less complicated more efficient (Jean-Charles, 2012). A Ushahidi representative posits the rejection of Ushahidi to programming language issues, Noula programmers and developers were familiar with Microsoft coding language (.net), a proprietary software, while unfamiliar with .php language used by Ushahidi's softare, a general server-side scripting language used to develop dynamic web pages (Baker, 2012).

Innovation and Evolution

The Noula platform was created after the founder and his team realized a *need* to gather critical information about emergency services to coordinate efforts amongst disorganized humanitarian organizations. Asides from radio stations, there were few responders who could listen to victims or collect information on damage and conditions on the ground. Since radio – although the primary source of information and communication for many of the disaster affected communities - could not effectively record such information, the idea emerged to develop a web page to amass information on community needs. The utility would be derived by gathering critical information and displaying this on a publicly available web page accessible to various emergency responders to act upon or fill with their own unique knowledge and information, assisting with coordination efforts (Jean-Charles, 2012).

Essentially, there was an identified problem for which there was no existing solution in place in Haiti. This all happened in the immediate weeks following the January 2010 event, the call center was up and running before Solutions S.A. had met Ushahidi. Although, one employee (intern) of Solutions had previously worked for Sahana, a similar open source software that provides emergency responders with critical information. In this sense, although it seems that international technology provided a source of inspiration, the platform was a locally developed solution to an identified problem for which there was no

existing local solution. One can speculate or hypothesize as to whether the Noula platform was a direct derivation or imitation of the international Ushahidi software, but from the initial problem identification down to the different software's employed by both organizations, it seems more likely that Noula was less and imitation and more a domestic innovation.

	Existing AIC Solution	*No AIC Solution*
Suitable solution for DC	*Technological transfer?* **Ushahidi and Sahana existed but were impractical**	*Locally developed solution to problems posed in DCs ?* **X**
No suitable solution for DC	*Solution but not suitable?*	*No solutions?*

Fig 4.4: Scarcity induced innovations (SII) Matrix to determine the nature of the innovation (Srinivas & Sutz, 2008)

Unique features?

The Noula platform departs from Ushahidi's model in many aspects of the execution:

1. Categorization: The Noula platform differs from Ushahidi in the it's categorization of events, the Noula platform incorporated more long-term needs such as 'Employment and Socio-economic Assistance' where as the Ushahidi platform was looking more specifically at crisis events. In another observation, Noula has fewer variations in categorization than Ushahidi, who's categories were constantly broadening.
2. Call center: The call center enabled Noula to create direct linkages between the disaster affected community in Port au Prince and the humanitarian response, most likely one of the main reasons why Ushahidi wasn't as successful as Noula. The operators are Solutions S.A. staff and speak Kreyol.[12]

[12] According to an IFRC Beneficiary Communications Evalution, 85% of Red Cross beneficiaries surveyed were happy with Noula's call center.

3. Applications: Several applications were developed that build off the Noula call center, developed by Solutions in tandem with clients: 16-6[13], Radio Tap Tap[14], Chimen Lakay, private call centers, etc. These applications are customizable and developed by Solutions S.A. staff.

	Ushahidi	Both	Noula
Characteristics/Features	- Strictly SMS based - Relied on outsourced volunteers - Born out of international civil society - Open-source software	- Mapping of crisis events - Information made public - Crowd-sourcing of information	- Both SMS, voice-call, and web based - Operated by local paid professionals - Developped using proprietary software - Developed various applications for other clients

Fig 4.5: Chart of similar characteristics and differences between Noula and Ushahidi

Ushahidi platform

	USHAHIDI	NOULA
Open-source?	X	
Crowd-source?	X	X
SMS-based?	X	X
Internet required?		
Public Information	X	X

Fig 4.6: Chart of similar characteristics and differences between Noula and Ushahidi

[13] 16-6 is a Red Cross and IOM project initiated with Noula and the Government of Haiti (GOH) to provide information about a family relocation programs in the IDP camps, the goal is to try to resituate tent camp residents to more permanent housing. Beneficiaries can call the hotline to apply for the program and to receive more invormation.

[14] Radio Tap Tap is a program developed by a local journalist in conjunction with Noula, the radio program is recorded on dvd's and is distributed to informal transportation vehicles which comprise the "public" transportation in Haiti. The radio program incentivizes listener's to call Noula's free hotline for the chance to win a prize.This data is used to provide transportation media metrics.

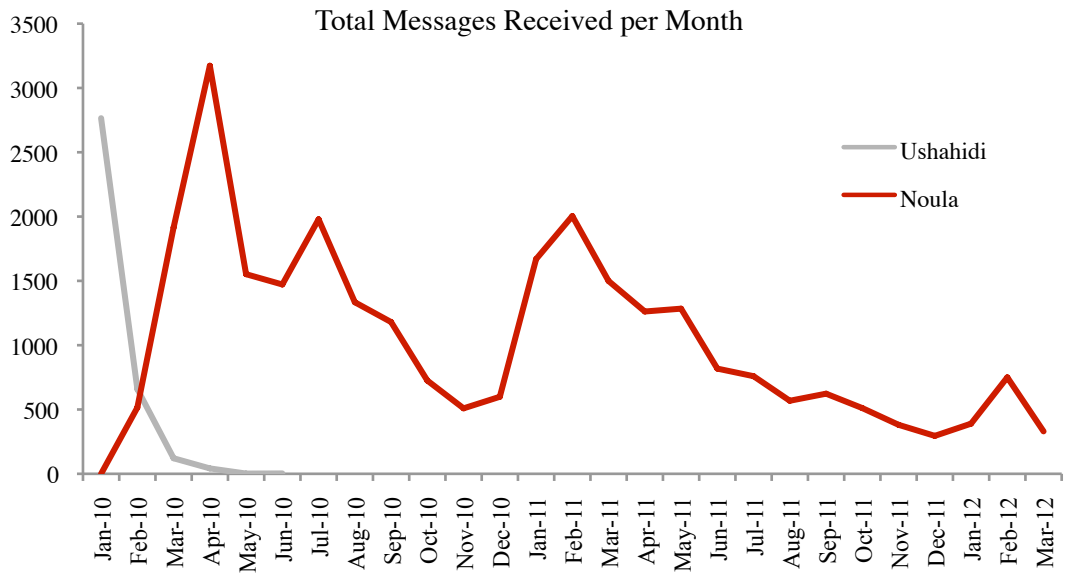


Fig 4.7: Graph of number of total messages received by each platform over the course of the project lifecycle. The Ushahidi platform was short-lived and had exited by July 2010 while the Noula platform saw fairly sharp spikes in usership with a gradual decline in messages, this could be a result of fewer emergencies or crises or it could signify a frustration with a lack of response or the dying a fade. [Source: Ushahidi-haiti.org, noula.ht; 2012].

As observed in Figure 4.4, the platform was successful in generating feedback and participation from various communities. The platform wasn't advertised but the number was spread via word of mouth. Interest peaked during the first 4 months that the platform was operational and has declined since then with a few spikes (perhaps indicating a disaster event, i.e. Cholera outbreak in August 2010). This might be attributed to the fact that there was a high demand for interaction and communication with public and civil society responders – but because of the lack of actionable responses that resulted from use of this service, interest in the platform has steadily declined. This is an indicator that if this platform were successfully institutionalized to the point where information was consistently acted upon, it could be widely utilized by the population.

Adoption by State Agencies

The initial intention of Solutions S.A. was to build up a platform that could function as a community needs assessment tool and also as a regulator to monitor different humanitarian organizations and generate information that could be relayed to governmental ministries (Carlson, 2012). Once fully

developed, the platform could then be handed to the state for management, the hope being that the platform would help to enhance the capacity of the public sector (Jean-Charles, 2012). Members of both Noula and Ushahidi were actually contacted by a public liaison responsible for the management of strategic information in the aftermath of the earthquake, to develop a system that could be of use to the Haitian Department de la Protection Civile (DPC) - the unit responsible for disaster risk reduction funded by United Nations Development Program (UNDP). The representative was interested in creating a standard system for registering displaced people – one of the OCHA[15] goals – as well as for promoting "effective tools to alleviate the crisis and the suffering in the aftermath of the quake" (Jean-Jumeau, personal correspondence, February 4, 2010). According to the founder of Noula, the public liaison offered valuable input on what would be critical for the state's use and offered information on how best to lobby with governmental entities(Jean-Charles, 2012). Thus the platform appears to have been developed in tandem with input from public sector representatives.

Although there was strong will from actors on both sides of the platform, this hand-off was never successfully completed. The initial assumption that the platform could enhance the capacity of the public sector was found to be problematic since, as the developers learned, the 'state' is not a consolidated body but rather consists of various uncoordinated entities (Jean-Charles, 2012). The firm had to make the decision whether or not to proceed with donating the platform to the DPC, which would have granted them the opportunity to show humanitarian responders and international aid organizations that they have resources and capacity to make an impact. However, doubts about the state's capacity to manage or maintain the platform prevented Solutions S.A. from handing it over, for fear that the platform would fade out within a few weeks or months and would cease to be a resource for the community (Jean-Charles, 2012). The firm eventually retained the platform to ensure its longevity and financial sustainability.

[15] The Office for the Coordination of Humanitarian Affairs (OCHA) is a department of the UN responsible for "ensuring a coherent response to emergencies", their first listed goal is to "Mobilize and coordinate effective and principled humanitarian action in partnership with national and international actors in order to alleviate human suffering in disasters and emergencies". OCHA. (n.d.). Who We Are.

Thus, the failure of the transition of the Noula platform from the private to public sector occurred on two levels: 1) the state, which was reluctant to assume responsibility, and 2) the firm, which lacked confidence in state institutions to maintain the platform. One member of the Ushahidi field team posits the rejection of the platform to the state's fear of responsibility (Carlson, 2012). Since flows of information about citizen need make governmental agencies (and traditional humanitarian responders) accountable – there is a certain risk involved when taking on this responsibility. According to the public information liaison, a formal engagement with Noula would add another item to an already overwhelmed agenda/system (Jean-Jumeau, 2012). Governmental entities do not have the human resources or the capacity to adequately respond to community needs. Therefore there is hesitancy to engage in a platform that would make them responsible. To directly quote the Ushahidi representative, "if the tool is too sharp, you don't want to hold it."(Carlson, 2012). Additionally, it is not within the culture of the Government of Haiti to respond to citizen need. With such weak capacity, there is little room to respond; this coupled with issues of corruption could have contributed to the failure of the system transfer.

This is not to say that there haven't been successful short-term engagements with the state; during Carnival, the justice department, police and office for public security partnered with Noula to provide 24/7 coverage of the festival. In the perspective of the Noula founder, this was a more successful engagement and successfully saved a life, the success of this program has led to more permanent discussions about monitoring for mental illness in the city as well as kidnapping prevention. Charles attributes the success of such a program to have been a direct result of personal engagement and commitment, regardless of the small budgets.

Despite ensuing discussions and collaborations with state entities, a realization that the call center couldn't function in isolation - meaning it does not have significance or relevance on its own - led the founder to forge partnerships with a growing list of responders. Since at the moment, the primary responders remain large NGOs, this is the repertoire of Noula's user group.

Adoption by Humanitarian Responders

Red Cross and IOM are large international organizations that have created private applications with Noula. According to Ushahidi representatives, the Red Cross represents an idealized model of Noula information usage (Carlson, 2012). Red Cross set up a private call center through Noula to open communication streams with its beneficiaries in IDP camps by calling 177, this functions primarily as a center for receiving and logging complaints within the camps and also provides vital information about various relocation programs and services to confused beneficiaries. Overall, this program has been successful since its establishment, according to a Red Cross report, about 85% of interviewed beneficiaries found the information they received useful and appreciated the service since having a human connection "shows respect" for the beneficiaries (Reader, 2012). Beneficiaries are motivated to use this service as opposed to consulting with community liaisons who are deployed in the field because there is a lack of trust in the community field workers, an assumption that the field worker would provide inaccurate information. Additionally, an International Federation of Red Cross (IFRC) representative expressed that beneficiaries felt more comfortable speaking with an intermediary rather than complaining directly with the organization. Noula sends IFRC an excel spreadsheet at the end of each week with call data, which one IFRC staff member will review and will expand upon. Solutions S.A. is compensated for the services they provide, which is enough to operate off of, this rate is cheaper than employing 2 full-time staff at Red Cross.

	Noula	Ushahidi
Humanitarian	MINUSTUAH GBV Reference Group IOM Red Cross UNICEF OCHA	US Coastal Guard US Southern Command (Marines)
State	MSHPP DCP Police	

Figure 4.8: List of users and partners for each platform, clearly Noula had engaged more users. This may be attributed to the outreach efforts on both Ushahidi and Noula's end to tap into the traditional humanitarian response to solicit this system. While the Ushahidi platform was found to provide minimal utility to the humanitarian response –

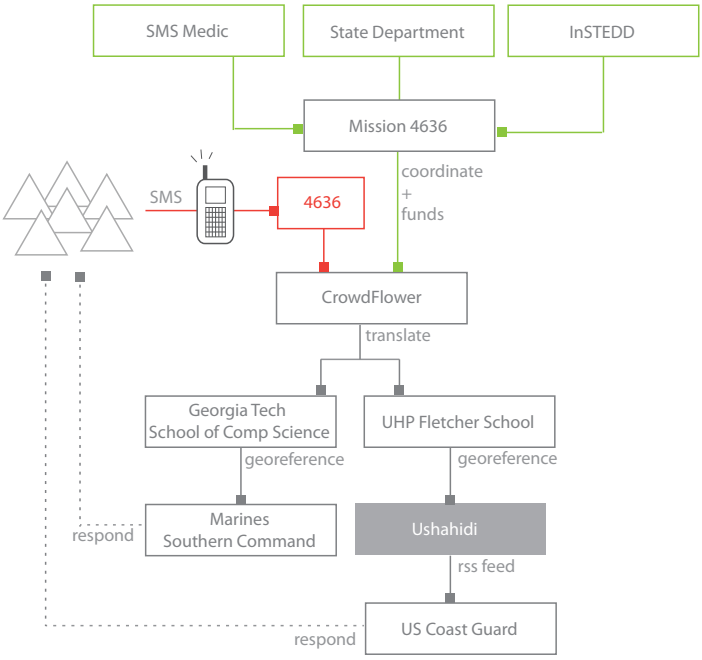
because of a lack of understanding about this process and the information systems already in place - my assessment details the utility of the Noula platform to each of the listed actors; some found great utility in the service provided by Noula while others remain on this list only nominally but don't actually incorporate the information into decision making processes.

Human Resources

The founder of Solutions S.A. recruits most of his programming staff from university programs, specifically the computer-engineering program at the University d'Etat Haiti (UEH) Science Department, where his spouse is a professor. There is a tight-knit burgeoning tech community in Port au Prince linked to academia – such programmers are found to be more willing to share and thus produce more innovations – however, much of this human capacity is absorbed by international organizations or large international corporations (i.e. Digicel, Comcel, etc.). The founder has also recruited people from civil and electrical engineering programs as well. In the second phase of Noula, the founder took recommendations from employees for other interested personnel whom he would then provide trainings for. Additionally, experts in fields such as psychology were invited to provide insights and trainings to call operators on how to manage anger, frustration, and to prepare scripts for callers. Although many of his programmers have around 10-15 years of experience, he's found the better programmers to be those with passion and dedication; these are more important aspects than skills or technology (Jean-Charles, 2012).

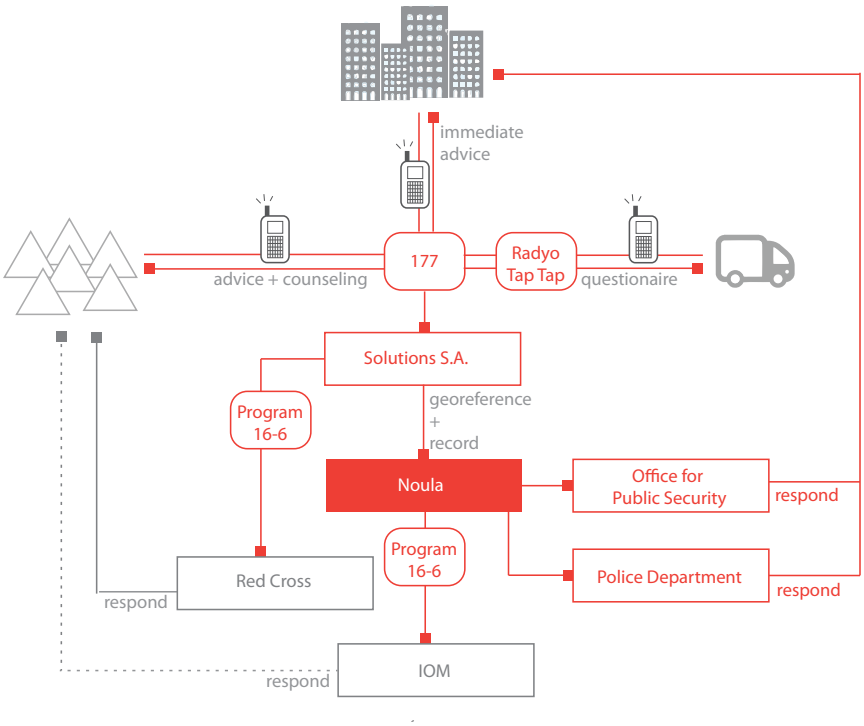
Communication Mapping:

Mission 4636



- No 2-way flows of communication
- Not a closed loop system
- No derivations
- No certainty of efficacy
- 8 Foreign Actors
- 0 Local Actors
- 0 state actors
- Not tapped into formal humanitarian response

Noula



- 3 2-way flows of communication
- 2 definitive closed loop systems
- 4 derivation applications
- 2 Foreign Actors
- 3 Local Actors
- 2 state actors
- Tapped into formal humanitarian response

Case 2: OpenStreetMap Haiti

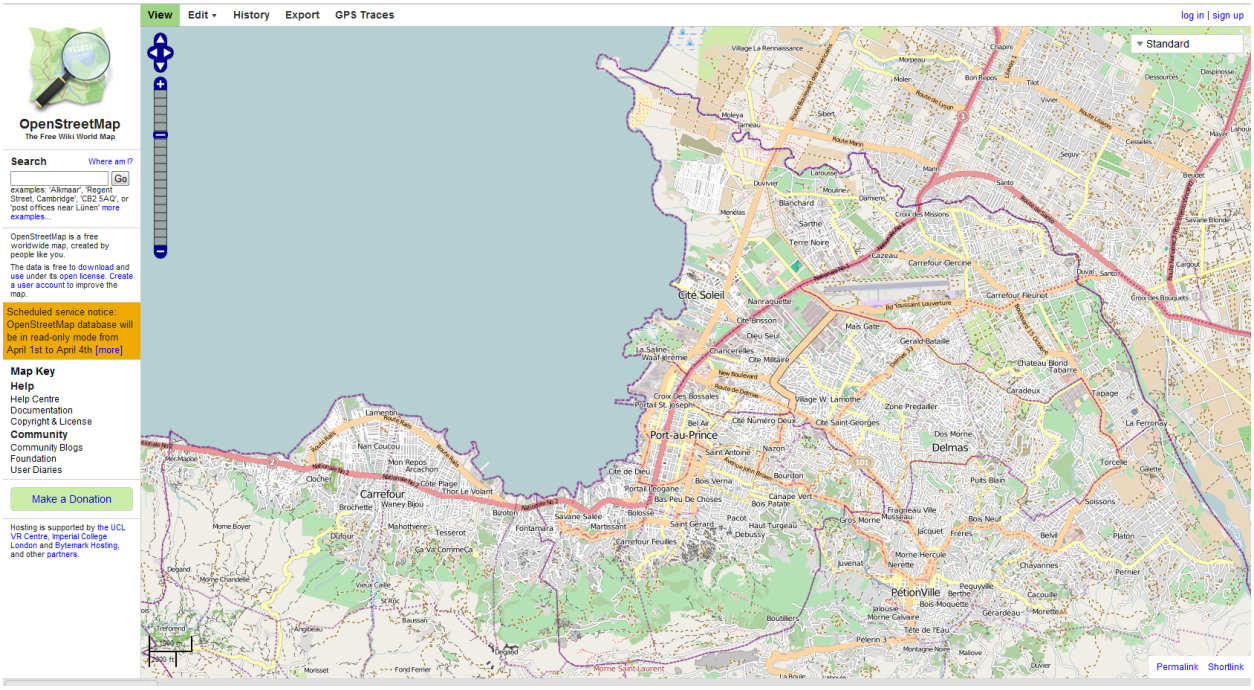


Fig 5.1: Screen shot of the OSM interface and the Port au Prince map [Source: OpenStreetMap.org].

OpenStreetMap is an open-source software and crowd-sourced mapping platform for generating spatial information, as an answer to Google's proprietary monopoly on geospatial information. OSM is managed by the Humanitarian OpenStreetMap Team (HOT), an international non-governmental organization. Immediately after the earthquake, HOT worked to collect geographic information from multiple satellite imagery providers such as: NOAA, GeoEye, Google and the World Bank. Information was then input onto an open source online map by crowd-sourced volunteers, generally of the international community.[16] This was done primarily through remote internet connection using satellite imagery provided by major providers as a base. Emergency responders such as IOM and the Office for the Coordination of Humanitarian Affairs (OCHA) utilized this information. OSM is published under and open license but is attempting to relicense under the Open Database License (ODbL):

> The Open Database License (ODbL) is a license agreement intended to allow users to freely share, modify, and use this Database while maintaining this same freedom for others. Many

[16] Crisis Commons volunteers were called upon to create and upload geospatial data containing information about addresses for emergency responders.

databases are covered by copyright, and therefore this document licenses these rights.(ODC Open Database License (ODbL)).

Local Adaptation and Innovation

The OSM platform itself was not a new innovation amongst the international community, however in the context of Haiti, it was a novel technology. The platform has been run jointly for the past 2 years by HOT and a Haitian non-governmental organization, Comite OpenStreetMap d'Haiti (C-OSM.HA), which recruits volunteers out of Cite Soleil – again another tight-knit community dedicated to absorbing the skills necessary to manage their own software/platform. C-OSM.HA is generally concerned with maintaining democratic internal organization and the group is subdivided into technical groups, i.e. strategy, developers, etc. However, according to the head of the group, the process has not quite yet been regulated as there is a learning curve involved with more technologically advanced projects (Alcin, 2012). It became clear after conducting subjective observation during an internal staff meeting that there is a strong desire for the Haitian organization to become more independent and assume more responsibility rather than continuing to depend on international support from HOT. Yet it is recognized that there is still a strong need for technical support and continuation of free resources to maintain the project.

The hiring of Haitian staff to implement the mapping activities indicates that spatial information is being generated with more local knowledge and therefore might be less susceptible to error. All 21 employees begin as volunteers who undergo trainings on how to use GPS trackers, but then eventually can be promoted to full time employees. This has sparked somewhat of a "movement" locally, with over 300 participating in trainings in Leogane, Jacmel, Gonaives, Cite Soleil and St. Marc (Chavent, 2012). A number of former volunteers are now employed by IOM or are full-time staff for C-OSM.HA. Volunteers use handheld GPS trackers to geo-reference "humanitarian" points of interest and roads, mapping is becoming more mobile with the increasing prevalence of android handsets which can record your geo-location and can be added to OSM instantly. Anyone can upload data onto the platform but this data is edited and verified in certain cases by the OSM team – who closely monitor edits and can identify when

inaccurate edits are made. In this sense the platform is becoming more accessible, but androids are still unaffordable to a majority of the Haitian population, meaning that crowdsourcing is limited to trained members and to the international community. C-OSM.HA still uses OpenStreetMaps universal open source software.

Adoption by the State

The head of the HOT Haiti team informed me that the platform design was intended to be "scalable and adaptable to humanitarian needs both urgent and long-term" (Chavent, 2012). However, this neglects the incorporation of the state as a key player in the scaling of such a platform. Although C-OSM.HA is engaging in scaling-up activities, this is being promoted through large bilateral and multilateral aid organizations rather than through public sectors. For example, USAID recently funded a 3-month long contract to C-OSM.HA / HOT to map a smaller town to the north of Port-au-Prince, St. Marc. This project is in the process of being completed. The expansion to outer lying areas of Haiti indicate a wider coverage achieved by this platform but this raises the question of how sustainable this platform will be if it's reliant on external funding and assistance to implement such mapping initiatives.

Another issue that must be taken into consideration is what service OSM provides to the Haitian public – is OSM solely a humanitarian service for humanitarian organizations or can Haitians actually use OSM. Can it facilitate planning processes or contributing to information sharing between public entities and NGOs. Lack of Internet access amongst the general population clearly acts as a major impediment to its wide-scale use, moreover, Haitians don't have a "history" of mapping leading most rely on innate knowledge of their surroundings. Interviews with planning professionals in the private and public realm indicate that planning agencies don't generally rely on OpenStreetMap for more than a preliminary assessment of a situation. In these opinions, data is usually not accurate or reliable. For accurate geospatial data, the national department of geo-spatial information (CNIGS) is called upon. When CNIGS doesn't have the data set needed, the planning agency/organization will conduct their own research or surveys to generate such information (Coicou, 2012). Since data is not perceived as accurate enough to

base plans or analyses off of, it could offer utility in terms of information sharing and prevention of duplication of efforts. However, although some of the organizations interviewed expressed desire to upload their data to the OSM platform, the open source software poses issues of interoperability. Most organizations collect information in a proprietary software, ArcMap GIS, which allows for more data analysis and manipulation but OSM uses slightly different software, Potlatch (2)[17]. Potlatch is not easily convertible to or from GIS shape files. Additionally, OSM is too fundamental to handle complex shape files or geo-databases that contain vital information (Stinson, 2012). Once NGOs have collected their information and entered it into their own geospatial management software, the act of converting it into OSM is often sidelined and often is never completed. Many of the organizations also feel that their work is proprietary or confidential so are reluctant to upload it onto a global database. Although one of the primary pillars of OpenStreetMap is to make spatial information files accessible to the public to identify gaps and overlaps in the system, these impediments prevent OSM from successfully acting as a nation-wide database of geospatial information.

C-OSM.HA does provide many trainings, however, this is not done systematically. The HOT representative informed me that OSM worked with the local government on training to reinforce the capacity and to generate and manage data and risk reduction efforts, the Ministere des Travaux Publics, Transports, & Communications (MTPTC) and Direction de la Protection Civile (DPC) were listed as key governmental departments in these efforts (Chavent, 2012). But this information remains unverified. For instance, during a project in St. Marc, the goal was to train youth which were recruited from local schools. According to participants, the local mayor was aware of the ongoings and came to observe one of the trainings but neither he nor his staff were included in the trainings.

[17] Potlatch2 is the newest system on OSM, however 18 other editing softwares are available depending on broadband connection and processing capabilities, JOSM is the most popular desktop editor which is a Java application. GpsMid, iLOE, Mapzen POI Collector, OpenMaps, OSMapTuner, Vespucci, and Bluemapia work on iphones and/or androids.

	HOT OSM	C-OSM.HA
Open-source?	X	X
Crowd-source?	X	X
SMS-based?		X
Internet required?	X	X
Public Information	X	X

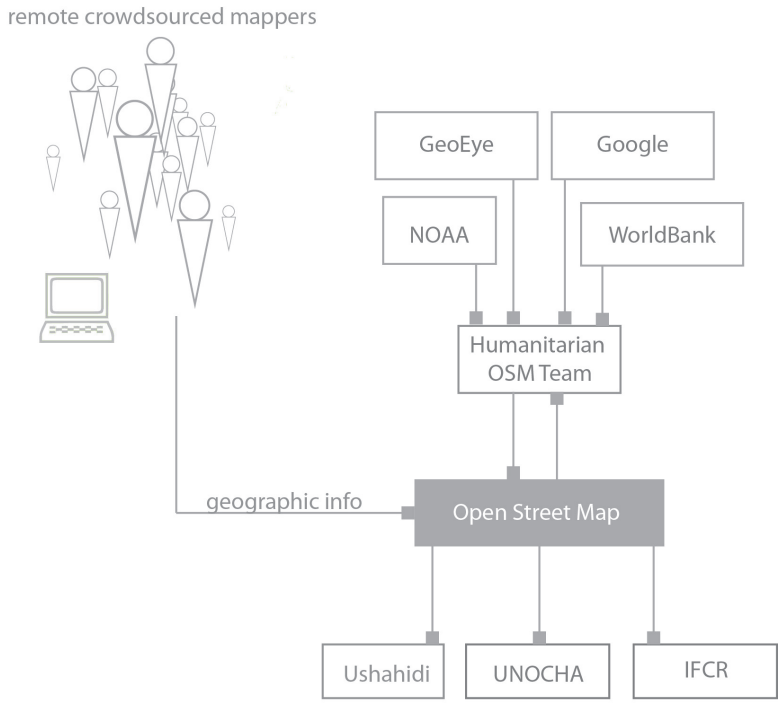
Fig 5.2: Chart of similar characteristics and differences between OSM under HOT management and C-OSM.HA mangement

Benefits:

Following the earthquake, the ability for foreign responders to identify and locate areas of intervention was problematic in the absence of clearly defined street names or addresses. For this reason, the quick implementation and crowd-sourcing of OSM to provide spatial information in Haiti was essential and critical, the main benefit being the addressing of streets. However, questions about long-term viability of this platform are under scrutiny. The OSM platform has remained generally unchanged with the exception of the addition of C-OSM.HA.

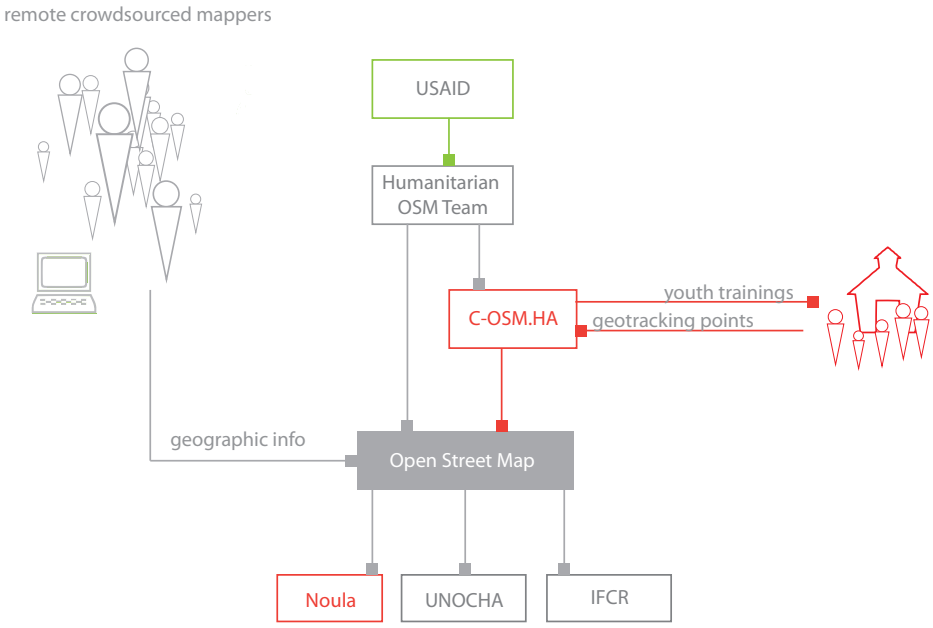
Communication Mapping:

Humanitarian OpenStreetMap Team



- 1 2-way flows of communication
- 0 derivation applications
- 8 Foreign Actors
- 0 Local Actors
- 0 state actors
- Tapped into formal humanitarian response

Comite OpenStreetMap d'Haiti



- 1 2-way flows of communication
- 0 derivation applications
- 4 Foreign Actors
- 2 Local Actors
- 0 state actors
- Tapped into formal humanitarian response

Case 3: WASH

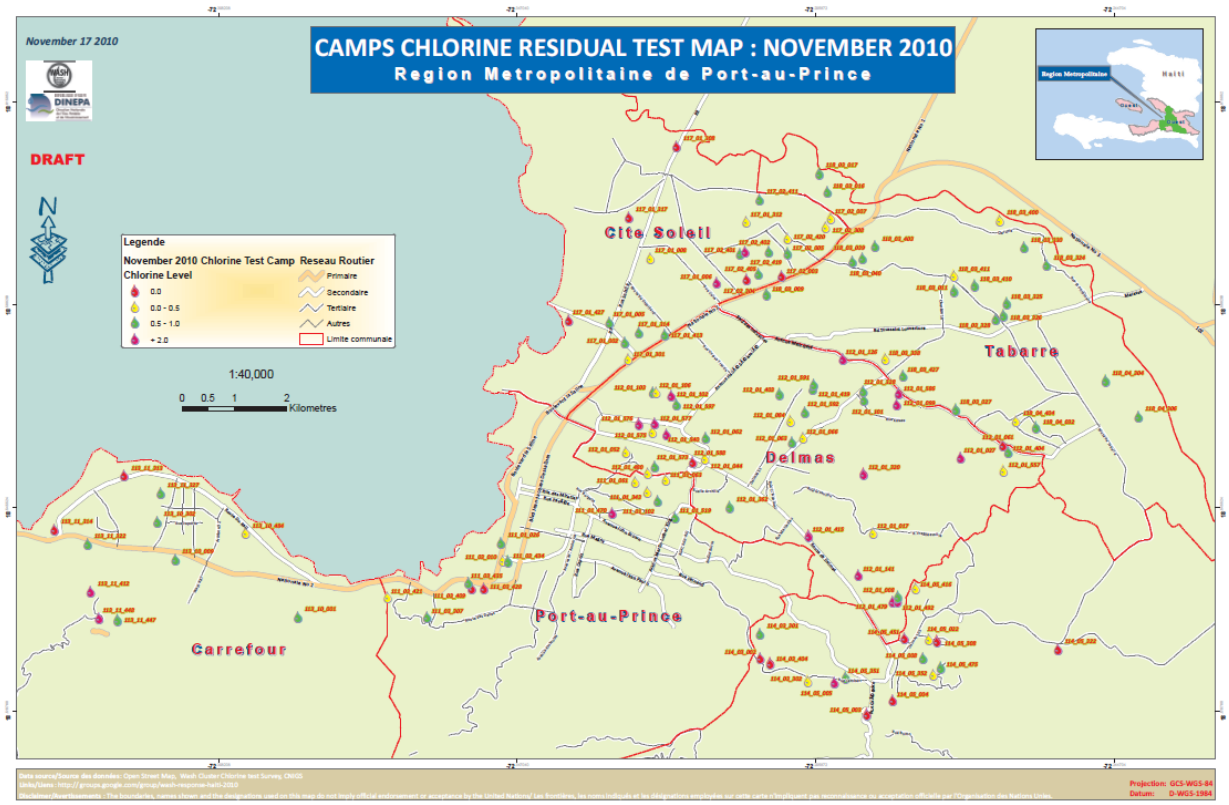


Fig 6.1: Map generated from SIS-KLÒR water testing data [Source: DINEPA].

SIS-KLÒR

Unicef is the UN department, which during the disaster response period was in charge of the cluster that promotes hygiene and clean water and sanitation practices called WASH. The cluster system was initiated after the 2005 Sudan emergency and uses a sectoral approach to disaster releif whereby each organization or department in the UN is responsible for a certain sector. Since there was no emergency response system in place for information management, Unicef created an information management system using the 3W matrix (who? what? where?) to coordinate efforts of various responders working in disaster relief. This system relied on the NGOs responsible for the camps to submit a report about their activities regarding water sanitation and hygiene to prevent overlap. However, this turned out to be problematic since few NGOs would submit their reports and those that were submitted were often missing information or were submitted in various formats that were difficult to compile or manage in a central

database. The processing of such reports consumed about 80% of the cluster's work and the information was ultimately not used (Urruela, 2012).

After the Cholera outbreak in September 2010, the lack of such a system became increasingly evident. The SIS-KLOR information management system was thus developed to manage and monitor water and sanitation in IDP camps. The system was designed specifically by the Haiti-based Unicef team located at the Logistic Base[18] in Port au Prince for internal monitoring; the software itself was developed by the PanAmerican Health Organization (PAHO). The system decreased reliance on NGOs for information by enlisting a field team of 20 field surveyors to monitor the IDP camps in 11 communes based on observation – and sometimes on questioning residents. These indicators included: latrines, hand washing facilities, showers, hygiene promotion activities, and water distribution. However, the survey utilizes simple "dumb" phones to submit information via SMS, using a code that contains the test results for chlorine levels in water sources and the geographic coordinates of the source. In this way, no geo-referencing is necessary and the data can be automatically translated into excel using the software developed by Unicef and PANHO rather than having to be entered manually into excel, which can enhance the efficiencies of the state departments (Valentz, 2012). If there were an issue with one of the test results, the camp could be alerted immediately. This information is also converted into maps for monitoring and evaluation and long-term planning.

	SIS-KLOR Unicef	SIS-KLOR DINEPA
Open-source?		
Crowd-source?		
SMS-based?	X	X
Internet required?	X	X
Public Information		

Fig 6.2: Chart of similar characteristics and differences between SIS-KLOR under Unicef management and DINEPA mangement

[18] The "log-base", or base logistique, is the central humanitarian organization headquarters where many NGOs and multi lateral organizations operate out of, the proximity of such organizations was meant to facilitate collaboration and coordination.

Direction National d'Eau Potable et d'Assainissement (DINEPA) – WASH

DINEPA is the national department of potable water and sanitation, which was formed in 2009 under a new law restructuring the standing department SNEPA and CAMEPA. Under this law, a regional office of potable water and sanitation was created as well as Centres Technique d'Exploitation (CTEs) in each town (27 in total). In rural areas with populations of less than 2000, Komites Aprovisyon Do Potable Assainment (KAPA) were established to manage water networks. All employees previously working for the former departments maintained their positions under the new direction (Valentz, 2012).

Adoption by the State

In August 2011, the SIS-KLOR water monitoring system was expanded to serve local hospitals in Port-au-Prince in addition to IDP camps. The national governmental department responsible for potable water and sanitation (DINEPA) shared responsibility for the information management of WASH and thus was the natural partner and successor of the WASH cluster – i.e. Unicef – and thus was mandated to assume responsibilities of the information management system. They underwent a transition period from October to December 2011, whereby all leadership and responsibilities were handed over from UNICEF to DINEPA. Two workers that were working under UNICEF direction have left and were directly hired by DINEPA, both of them Haitian and one of them a trained ArcGIS expert who previously was employed at the national center for geospatial information (CNIGS). In January, the balance of power was 1 team member from UNICEF and 3 members in DINEPA, the total number of team members has slowly diminished along with the need since Cholera is now less of a threat. Currently, the Unicef worker is not officially a member of the WASH response but still provides assistance in the form of technical support and transfer of knowledge and experience (Valentz, 2012).

This could be in part due to the funding they received from USAID to manage potable water and sanitation in the country, which was a priority in Haiti following the Cholera epidemic. In February, the system was been scaled up to a certain extent - as the national department is now piloting the project in

outer lying cities. At present, 7 different CTEs[19] are using the SIS-KLORR system to send in water test results, the other 20 CTEs still use paper-based systems or submit excel sheets. However, out of the 7 CTEs being tested, only 4 report information regularly while the other 3 never submit information. The DINEPA representative posited this to a behavior issue, citing the need to train the CTEs how to use the new technologies and promoting the use of the system. However, recognizing that training had already been conducted, another obstacle to effective integration was the high cost of sending SMS messages, which is funded by the local CTEs rather than the national department, fiscal constraints prevent local CTEs from participating (Valentz, 2012). One positive outlook is that the Minister of Education had approached DINEPA with the possibility of launching a water monitoring system in the schools in Port au Prince, to be launched January 2012.

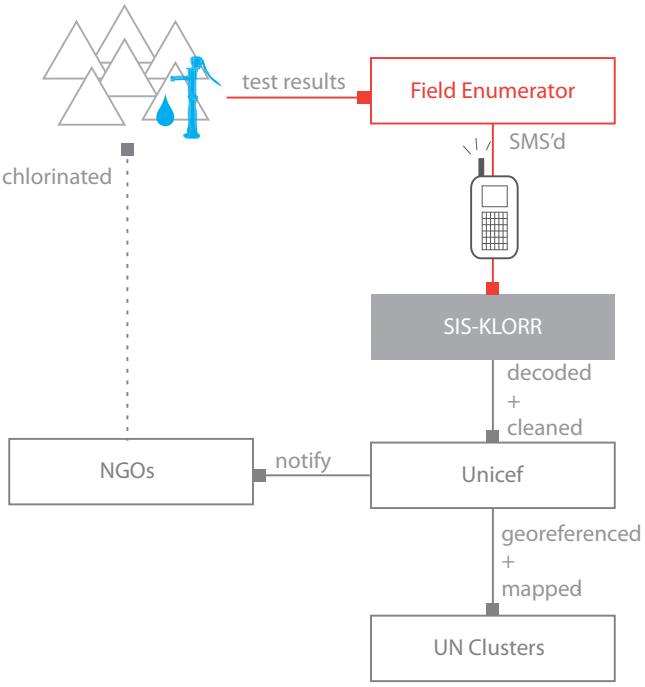
Innovation and Adaptation

In the case of WASH and SIS-KLORR, the innovation was driven by needs of the humanitarian response. Few external or local actors were involved in the innovation process, design or development. Initially, WASH was an emergency response system but now that it is being transferred to DINEPA, who is more interested in the long-term development of the country, the system may need to be reoriented and reengineered into a longer survey from which to launch a longitudinal study. A WASH survey was designed to be conducted monthly and to incorporate all 23 indicators based on the National Cholera Strategy. Since the initial design of SIS-KLÒR could only measure one indicator – the chlorine levels in the water sources – only a few indicators could be derived. However, since the software the platform was developed with proprietary software, any additional modifications to the system would need to be submitted as a pro-forma back to Unicef and PANHO which would take time to process and then re-develop. As the DINEPA representative mentioned, this "would be difficult" (Valentz, 2012).

[19] The 7 cities participating in the pilot are: Petionville, Croix-de-Bouquets, Jeremie, Jacmel, Miraguan, Petit Goaives, and Cap Haitien.

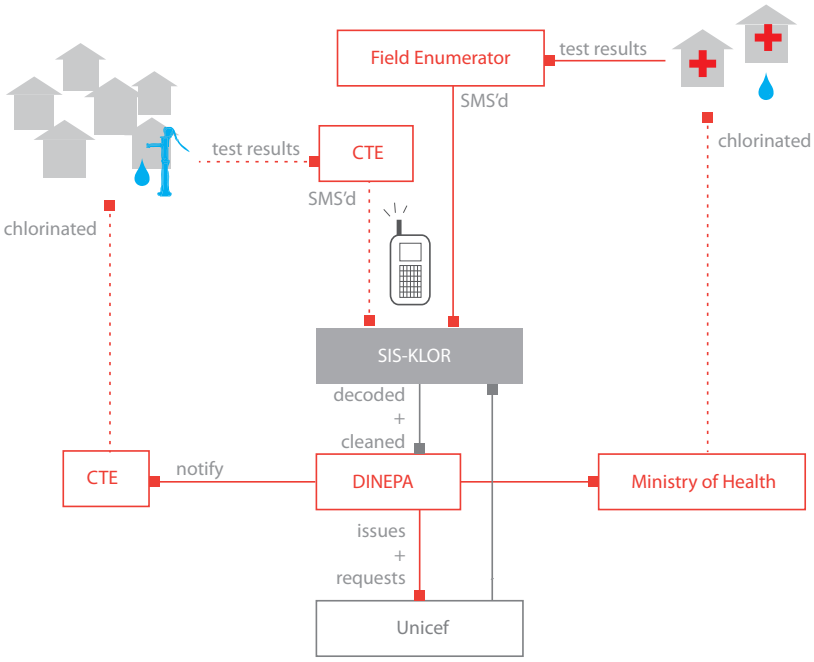
Communication Mapping:

SIS-KLOR (Unicef)



- 0 definitive closed loop systems
- 0 derivation applications
- 3 Foreign Actors
- 1 Local Actor
- 0 state actors
- Tapped into formal humanitarian response

SIS-KLOR (DINEPA)



- 0 definitive closed loop systems
- 0 derivation applications
- 1 Foreign Actor
- 4 Local Actors
- 3 state actors
- Tapped into formal humanitarian response

Summary of Cases

	Noula	**OSM**	**WASH**
Proprietary	Proprietary	Open Source	Proprietary
Government uptake	**Somewhat – 2 state actors** First attempt to transfer was unsuccessful due to limited capacity to respond to information requests and possibly fear of transparency	**Somewhat – 0 formal state actors.** DINEPA uses OSM spatial information for their base maps. Organizers claim to conduct trainings with local governments but this is unverified.	**Yes – 3 state actors** Transfer was facilitated by Unicef, but this was accompanied by funding from USAID.
Scalability	**Yes -** There has been uptake with a variety of humanitarian responders but nothing enduring with state entities. This is changing as dry-run collaborations have proved successful and effective, future collaborations are underway.	**Somewhat-** OSM has become the default GoogleMaps on account of its rapid production of geospatial information. Future activites for mapping rural areas are underway but are being funded and encouraged by large bilateral donors rather than through planning agencies.	**Somewhat -** 4/7 success rate, it seems unlikely that this will successfully transfer to local levels without more resources and training.
Suitability	**Yes -** Embedded with local knowledge of communication behaviors, this platform was more successful than its foreign predecessor, Ushahidi.	**Somewhat -** It is applicable to foreign aid workers but not necessary to locals who have inate knowledge of their surroundings and limited internet connectivity. One would need a smart phone to access the platform mobily.	**No -** Only 4/7 local CTE's are reporting information, most likely due to SMS costs. Additionally, although DINEPA would like to create a longer-term M&E survey, they are limited to 1-2 indicators.
Adaptability	**Yes -** Solutions developed and manages the software, many changes have been made over the course of time without bureaucratic delays.	**Yes** – Since the platform is opensource, this means that users can freely access source code and create derivative applications.	**No -** The platform is static. To make a request to change, the organization would have to submit a pro-forma.
Applications	**Yes – 4 derivatives,** the most amount of complementary applications were developed with the Noula platform.	**Yes/No – 0 local derivatives** Applications were developed to OSM global but not Haiti specific, these were also not locally developed.	**Maybe – 0 derivatives** Unicef might be applying the same software to monitor Jedco (a waste management company)
Demand	**Yes –** public, private, CBO's, multilateral orgs	**Yes –** humanitarian workers	**Yes -** public

As one can discern from the above chart, the Noula platform had greater suitability and also had a greater amount of derivations that were developed locally. One could extrapolate this to say that locally developed platforms are more suitable and will have more derivations than their foreign developed counterparts. This makes sense since the group that developed this application (situated in the private sector) had the technical skill set to adapt the platform to other uses and also the local connections to formulate additional partnerships with other local actors. Noula also had the most 2-way information flows, indicating greater participation.

In terms of government uptake, Noula was not as successful and was initially rejected as an information management and emergency response platform by the state department of civil protection (DPC). This was largely attributed to a fear of accountability – which implies that capacity of the state department to respond to the information was not sufficient enough to make the uptake of such a platform feasible. It is worthwhile to note that recent engagements have been more successful since the DPC's agenda has been cleared up mildly, allowing more resources to be dedicated such a system; timing is a critical factor in the introduction of such platforms. WASH was more successful since the national department of water had successfully taken over management of the platform. This could be a question of resources alone, since USAID had granted DINEPA several million to support capacity building efforts, this enabled the proper management of this software. However, it failed when attempting to scale this to a more local level. In this light, the theory of fear of decentralizing responsibility and power from the National level is dispelled since there have been concerted efforts at the national level to transfer the platform to a more local scale. This is telling of the capacity and resources at the regional and municipal levels; the failure was a perhaps a result of insufficient funds to send SMS messages at the rate required for sufficient monitoring of water quality. It could also be due to path dependency, although trainings had been conducted, certain regional bureaus didn't send in the required information (or continued to submit paper based forms) due to reorganization of existing procedures for water monitoring. Since the software

cannot be altered by the national department, the platform remains static and is reliant on a foreign entity for adaptations or derivations.

This is where open source software (OSS) could play a role in allowing for more derivations and adaptation but the only platform that used OSS, OpenStreetMap (OSM), didn't have any local derivations. This could be a result of an absence of local knowledge embedded in the software. It is likely that since the software was developed by an international organization, there is no ability or technical knowledge to change such code. C-OSM.HA, the managing organization, remains reliant on HOT, its international counterpart, for technical assistance and other international organizations for funding. Additionally, there is no formal engagement of state entities with this application – this perhaps is a result of the perception that crowdsourced information is not entirely accurate. It remains to be examined whether a formal public engagement would increase the scalability of such an organization.

Conclusion:

It should be recognized that while ICTs present valuable opportunities to increase efficacies of state operations and to create direct linkages between the citizen and the state, these technologies cannot function in isolation. Tangible social and economic benefits to both organizations and end-users alike can be provided through increasing transparency, creating accountability and empowering communities with a means to reach responding organizations, from which they have traditionally been isolated. Communities have responded positively to these platforms and technologies indicating that there is an ongoing demand and motivation to use these services. Ironically, it seems to be precisely for these reasons that these platforms were never genuinely accepted by the state. Monitoring mechanisms are inherent in these platforms, which makes participating actors accountable to the information received; deterring many public departments from utilizing or investing in such technologies. This also offers the possibility of holding international players accountable and coordinating their disparate efforts. Since international organizations have been the primary providers of disaster response and infrastructure development for the past few decades, capacity of the public sector to respond to information has been diminished and is not yet strong enough for these platforms to be effectively institutionalized. Drawing from Gros, as mentioned earlier in my literature review, "Haiti cannot respond adequately, if at all, to any natural disaster due to the absence of any organization of the state that can quickly mobilize human and technical resources" (Gros, 2011; 149). In this light, a more holistic approach needs to accompany the introduction of such technologies into the public sector including capacity building and accumulation of sufficient resources to both manage and respond to information.

Institutionalization of new ICTs

My research has indicated that new technologies have no significance in isolation. A critical mass is needed to support the technologies to grant value to them as tools that can enhance capacities of state entities. Based on interviews with parties involved in the utilization of new infocom platforms, it seems clear that it is not simply a failure in the state that is preventing such platforms from being institutionalized, it is a combination of factors including limited resources, lack of local ownership, and path dependency which render foreign technologies unsuitable and maladapted to Haitian use, impeding genuine uptake by the state. A more holistic approach will need to be taken to accompany the leveraging of these technologies as well as a nuanced understanding of local need, this could encompass building upon existing means of communication as well as supporting the local IT sector by bolstering intellectual property protection regimes to enhance intellectual capital markets and support innovation.

This taken into account, the integration of ICTs into planning activities and administrative functions could be successful at the national level where resources are concentrated, many administrators at this level have the necessary technical capacity and know-how to operate such technologies. At this level, the necessary infrastructure is in place to enable their operation. However, a challenge presents itself when scaling up and transitioning to micro-levels, such as the regional and municipal scales. According to one employee at the regional ministry of planning, "[the idea] is interesting but it probably wouldn't be useful because the population doesn't know about [these technologies] and the ministries do not know how to use them, it's too complex and expensive" (Charles, 2012). This issue might be easily overcome through trainings, however, the same official mentioned that if the nature of the communication or demands relayed through these platforms was urgent, then it would not be useful to governmental agencies because there is no capacity to respond; "if it could inform the situation, it could help, but not for rapid interventions" (Charles, 2012).

My cases illustrate that technologies must be developed with local knowledge and resource constraints taken into consideration. When technology platforms are developed exogenously, internal

staff does not know how to maintain or operate the systems. Platform 'leaders' –typically monopolistic firms – are usually responsible for pioneering the evolution of such platforms (Economides & Katsamakas, 2006). If this leader is exogenous to Haiti, it will not be possible for these platforms to evolve as needed to suit long-term planning needs, especially for a platform specifically developed for public administrative purposes. If there were a need to modify the platform, to adapt to local idiosyncrasies or for example, to reorient indicators towards long-term planning questions, then the adaptation would have to be facilitated by the external entity; maintaining dependency on foreign organizations for basic operations and creating an added layer of bureaucracy which prevents the necessary evolution of technological change. For this reason, foreign technologies are static and don't allow opportunities to modify or evolve. Although large-scale platforms may initially augment efficiencies within the state, as they are being provided for no cost and trainings occur simultaneously, in the end they will be dependent on foreign bodies for operating cost-intensive information management systems (since systems are proprietary, the cost of the system is passed on to the end-user, the state). Once the initial donated licenses are expired, the state will be reliant on an expensive platform that will require ongoing maintenance and operation from foreign providers and will remain relatively static.

However, to establish institutionalization of ICTs amongst state entities, necessary capabilities need to be in place with which to manage and respond to the information being generated. Otherwise, organizations will be averse to adopting certain platforms since it makes the adopting organization accountable; there is a fear of failure associated with this as can be demonstrated by the Department of Protection Civile's rejection of Noula. If there is simply information management involved, then there is less risk involved and less reluctance to adopt. As in the case of SIS-KLOR and DINEPA, there is a distrust of platforms developed by domestic firms, especially for private sector firms where there is a suspicion of rent seeking. States are faced with the choice of receiving free software from a foreign firm or paying for products developed by domestic firms. The issue here is that domestic products come with upfront costs whereas there is a conception that foreign aid organizations will provide platforms and

along with this, donations; this as we know however, is not a sustainable strategy. Thusly, the adopting entity is obliged to adopt the foreign platform due to its already sparse resources.

Existing plans to invest and implement a comprehensive e-governance platform for information sharing and management are well-intentioned and recognize the need for such platforms, however, these fail to address the local supply chain. The procurement strategy outlined in such plans are designed, planned, and financed by large multilateral organizations whilst the GOH is only responsible for execution and management. Additionally, the procurement strategy is being planned in conjunction with a monopolistic firm who has donated licenses, this firm has identified a set list of providers for hardware and equipment that are compatible with their licenses and the GOH can choose from this list based off of a price comparison. This logic seems sound, however, will result in the procurement of foreign providers (i.e. from Microsoft's list) rather than acting as a demand-based tactic to induce domestic innovation and production. Also, once this funding reaches its expiration date, 24 months, the GOH will be responsible for paying for the operations, maintenance, and replacement of system parts. Operating Microsoft software is more expensive than its open source counterparts (in Munich the Mayor saved €4m in one year from switching). It is unclear how long the licenses donated by Microsoft will last, but once the system is based on Microsoft, switching costs will be too high to switch to another operating system. This strategy has largely been employed by international donors who have been focused investment towards the development or implementation of existing foreign ICT systems rather than identifying the local talent and incentivizing these to produce the needed systems to address the supply-side.

Although certain platforms are being adopted now at the national level, it becomes uncertain whether they will successfully be scaled or reoriented towards long-term planning. It will be interesting to observe what happens to these platforms once the donor funding supporting their uptake is withdrawn.

Innovation:

To classify innovations in ICT that have emerged in the post-disaster environment, the majority have undoubtedly surfaced to meet social ends, which offers valuable opportunity to provide social protections. However, to use Courvisanos terminology, although certainly transformative when applied in Haiti, in the international context they have been incremental at best (2000). Crisis mapping and SMS-based technologies are hardly revolutionary and many of the same platforms have been and continue to be applied to many different environments without the necessary modifications. Policies are needed to encourage the development of local innovations in ICT that are more suitable to resources and capacities in Haiti and that are adaptable and dynamic as needs will change from disaster response to long-term reconstruction. However, high risk associated with such innovation and outdated legislation continues to be an obstacle to this end.

My analysis indicates that technological change in the ICT sector has been predominately driven by the international community due to the institutional and regulatory environment in Haiti. Effectively resulting in the application of technologies developed in advanced industrialized economies associated with abundancies of inputs, to a post-disaster environment associated with extreme scarcity. As noted by Srinivas and Sutz, scarcity environments encourage innovation in processes and products (2005), however, there has been little incentive or stimulation of domestic organizations to reverse engineer, modify, or adapt these technologies to create more idiosyncratic platforms. Strict international IPR regimes increase the investment costs needed for research and development, this coupled with limited demand and no protection from domestic theft/imitation disincentivize firms from innovating. This has led to platforms that are not necessarily suitable or conducive to uptake, preventing existing platforms from being institutionalized. Increased state regulation of these markets and regulatory frameworks is needed to create a more conducive environment for local technological developments. The GOH has committed to investing in this sector, but rather than investing in hard costs for improving infrastructure, more resources could be channeled towards schemes developed to create incentive for innovation.

Theoretically, OSS seems a valid approach to lowering entry barriers for innovative firms in developing countries. Existing software is publically available for zero cost and can easily be modified, adapted, and bundled into an application, service, or database which can be made into a public good or which can be made excludable to end-users and competing firms to derive profit. However, my research has indicated that adoption of these platforms amongst the competitive private sector in Haiti has been lagging. This could be due to high switching costs and path dependency, since software developers are taught a certain programming language through education and experience, learning a new language is time consuming and makes maneuvering software more difficult. Certain OSS also may not offer as wide a variety of possible derivations as proprietary software do. However, an adoption of an OSS operating system, such as Linux, that would be more widely accessible could result in a standardization of operating systems, allowing for increased interoperability and helping to disintegrate vertical information silos amongst governmental bureaus. Extending these platforms to international aid organizations could introduce accountability mechanisms and promote information sharing. Investigating the limitations of OSS for inducing frontier innovation in late-industrializing countries is an important area for further research that this study has uncovered.

Most local innovations in ICT have been the result of combinations or "mash-ups" of existing technologies or media that allow the operators to reach broader population groups. These ICTs are embedded with a richer understanding of local communication behaviors, for example the preference for face-to-face interactions, which could enhance public participation and thus efficiency within the state. In general, these innovations have greater potential to be more transformative as they offer the opportunity to "redirect the trajectory of economic development" in Haiti (Courvisanos, 2000). My case studies indicate that a vibrant tech community is active in Haiti but large international civil society organizations (i.e. IOM) or private firms (i.e. Voila) are currently harnessing these skills. This is problematic because profits derived from these endeavors are not feeding back into the domestic economy. This latent capacity could be tapped into to act as launching points from which to stimulate a new supply-based application

market. Domestic tech firms and individuals can facilitate the development more idiosyncratic technologies that are embedded with a local knowledge not implicit in foreign innovations. Take for example the document encryption software developed by the student group at ESIH. However, these are constrained by outdated legislation that prohibits both innovation and uptake and use. Current practices also are reliant on proprietary software, which has higher barriers to entry and deters firms and individuals without enough capital to invest in upfront research and design from innovation.

It would be more efficient and beneficial to identify existing domestic capacity and invest in this sector rather than investing directly into technologies developed by foreign contractors that after initial pilot periods will prove to be inoperable due to excessive fees and costs associated with ongoing maintenance.

Recommendations:

Although I have specified that both supply-side and demand-side strategies must be addressed when considering the institutionalization of ICTs for planning purposes, the recommendations will be mostly be geared towards tapping into domestic capacities already in place (in the vibrant IT and software development community) through the creation of environment conducive to local innovation in ICT. In this way, Haiti can continue to modernize independently and develop and support its own ICT systems.

- *Open Source platforms – allow local firms to imitate and modify existing technologies and create adaptations*

  One example of this would be the use of OSS, which require switching costs, but allow the developer to freely study and modify existing software's that are licensed under "general public license" type agreements. The zero cost of entry lowers costs for both the end-user and the competitive firm, which could enable the development of a wider variety of proprietary applications. Applications could then be excludable and could be bundled or repackaged for profit. The introduction of more open source software's would enable a more innovative environment and create more system interoperability. Additionally, using open source software platform for information management, sharing, and production in the GOH could result in savings in the long-term. One municipality in Germany (Munich) has reportedly saved 4 million euro from switching from a Microsoft based system to Linux.

- *Creative licensing*

  In the absence of legal parameters for protecting intellectual property – and because the development and approval of such legislation will undoubtedly take time given the ongoing political instability in Haiti – creative licensing opportunities should be explored. In the international and technology space, specific organizations offer protection through various copyright and patent licenses. This allows for the building off of additional works while not reducing incentive to innovate since the application can still be sold for profit. A commonly used open source license is the GNU general public license (GPL) which provides an equal exchange for developers and promotes collaboration while still protecting work. Another option is the Apache

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- *Updated policy and legislation*

  Lack of domestic IPR protections are preventing local firms or organizations from developing new producs since these can be imitated by competitor firms without repercussion. Outdated legislation is also preventing uptake of ICT modernization in both the private and public sector because information can be a form of intellectual capital, and it is not protected in electronic form under current legislation.

- *Procurement that draws on domestic firms rather than international*

  Creating effective demand through a procurement process where the bids are awarded to domestic providers would be one method for bolstering local innovation. Rather than seeking out foreign firms for providing goods and services necessary to implement an e-governance platform, the national government could seek out existing local talents to develop the platform.

- *Investment in institutions of higher education*

  Drawing from Camara and Fonseca's emphasis on the facilitation of "low-high" innovations through public expenditure and investment in human resources, it can be advocated that investing in institutions of higher education could promote the development of technologies that are not easy to imitate or replicate through reverse-engineering but that have high value. Since these innovations typically take place through connections and collaboration amongst academic or software engineer networks (take Noula for example, as a private software firm connected to academic circles via his spouse), investment in these institutions could enhance human resources and capacity as well as promote academic collaborations.

These steps call for participation by several actors at work in Haiti, these include National level strategic planners and executive administration (establishing Presidential support is critical to enforce

policy) as well as different departments of the state who are capable of developing and enforcing such legislation, these departments include the bureau responsible for copyright protection and enforcement, the Bureau Haitien du Droit d'Auteur (BHDA), the planning department or Ministere de la Planification et de la Cooperation Externe (MPCE), the ministry of public works Ministere de Travaux Publics, Transports et Communications (MTPTC), and the Ministere de l'Economie et des Finances. International universities with specialized scholars in such subjects could also play a vital role in advocating for and informing intellectual property policy; for instance Université du Québec à Montréal's Departement de Management et Technologie which has experts in telecommunications in Haiti.

This paper also hopes to inform development practice by international ICT platform developers, who have introduced m-banking, m-health, ICT4 … etc, into many different emerging economies. While the aforementioned platforms have been innovative and have contributed significantly to enhancing certain capacities and functions in the interim, more thought should be attributed towards long-term strategies beyond training programs. As emerging economies industrialize and modernize (both at the firm and state levels), it is important that this modernization occur with resource constraints and local idiosyncrasies in mind to ensure institutionalization and uptake by both public and private sectors.

The building out of these steps by strategic planners could result in an environment that both stimulates innovation and institutionalization, providing a boost to the economic development in Haiti, particularly in the ICT sector, while building more suitable and adaptable technologies in parallel. Thus allowing technologies to become more scalable as they would be designed with a richer understanding of ICT behavior and institutional constraints. While theoretically, these technologies do provide the potential to augment efficiency within the state and enable the completion of certain tasks – i.e. manage and coordinate information and databases, generate geo-spatial information, and bridge the gap between the government and its citizens, etc. - it should be noted they cannot function in isolation. Infrastructure and institutional constraints exist that limit the uptake of such technologies and thus should be perceived as tools and not solutions. Additionally, before investing directly in the public sector, it would be more beneficial to invest and stimulate innovation in the private sector.

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APPENDIX A

Code Penal de Haiti

Chapter II "Crimes and Misdemeanors against Property" of the Haitian Penal Code.
Paragraph V "Violations of regulations related to trade and art"

Article 347: Any edition of writings, musical composition, design, lithography, painting and any other production, printed or engraved in whole or in part, in defiance of law and regulations relating to the property of authors, is a forgery and any forgery is an offense.
Article 348: The offense of infringing works, the introduction of Haitian territory of books which, after being printed in Haiti, have been counterfeited in the stranger, is a misdemeanor of the same species.
Article 349: The penalty against the infringer, or against the introducer, will be amended at least one hundred gourds and four hundred dollars at most, and against the debiting, a fine of at least sixteen gourds and gourds at eighty more . Confiscation of the pirated edition will be issued as against the infringer as against the introducer and the retailer. The plates, molds or matrices of counterfeit goods, will be confiscated.
Article 350: Any director, any entertainment organizer, artists' association, to be represented, at his theater, dramatic works regardless of the laws and regulations relating to the property of authors shall be punished by a fine of twenty at least four-gourds, gourds eighty at most, and confiscation of proceeds
Article 351: In the cases provided by the four preceding Articles, the product or forfeitures revenues confiscated, will be given to the owner to compensate all the damage he has suffered: the excess of the allowance or the entire compensation, if there has been no sale of goods confiscated, seized or revenue, shall be resolved through normal channels.

International IPR Treaties

Membership in WIPO, UN, and WTO administered treaties:

- Singapore Treaty on the Law of Trademarks
- Patent Law Treaty
- Berne Convention for the Protection of Literary and Artistic Works (January 11, 1996)
- Convention Establishing the World Intellectual Property Organization (November 2, 1983)
- Lisbon Agreement for the Protection of Appellations of Origin and their International Registration (September 25, 1966)
- Paris Convention for the Protection of Industrial Property (July 1, 1958)

Membership in international multi-lateral IP-related treaties:

- Protocol (III) additional to the Geneva Conventions of 12 August 1949, and relating to the adoption of an additional distinctive emblem
- WHO Framework Convention on Tobacco Control
- International Treaty on Plant Genetic Resources for Food and Agriculture
- Stockholm Convention on Persistent Organic Pollutants
- Cartagena Protocol on Biosafety to the Convention on Biological Diversity
- Convention on the Means of Prohibiting and Preventing the Illicit Import, Export and Transfer of Ownership of Cultural Property (May 8, 2010)
- Convention on the Protection and Promotion of the Diversity of Cultural Expressions 2005 (May 8, 2010)
- Convention on the Protection of the Underwater Cultural Heritage (February 9, 2010)
- Convention for the Safeguarding of Intangible Cultural Heritage (December 17, 2009)
- Convention on the Rights of Persons with Disabilities (August 22, 2009)
- Optional Protocol to the Convention on the Rights of Persons with Disabilities (August 22, 2009)
- Protocol (I) Additional to the Geneva Conventions of 12 August 1949, and relating to the protection of victims of international armed conflicts (June 20, 2007)
- Protocol (II) Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of Non-International Armed Conflicts (June 20, 2007)
- Kyoto Protocol to the United Nations Framework Convention on Climate Change (October 4, 2005)
- International Plant Protection Convention (October 2, 2005)
- Convention on Biological Diversity (December 24, 1996)

- United Nations Framework Convention on Climate Change (December 24, 1996)
- United Nations Convention on the Law of the Sea (August 30, 1996)
- Agreement establishing the World Trade Organization (WTO) (January 30, 1996)
- World Trade Organization (WTO) - Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS Agreement) (1994) (January 30, 1996)
- Convention concerning the Protection of the World Cultural and Natural Heritage (April 18, 1980)
- Convention (I) for the Amelioration of the Condition of the Wounded and Sick in Armed Forces in the Field (October 11, 1957)
- Convention (II) for the Amelioration of the Condition of Wounded, Sick and Shipwrecked Members of Armed Forces at Sea (October 11, 1957)
- Convention (IV) relative to the Protection of Civilian Persons in Time of War (October 11, 1957)
- Protocol 1 annexed to the Universal Copyright Convention as signed at Geneva on 6 September 1952 concerning the application of that Convention to works of stateless persons and refugees (September 16, 1955)
- Protocol 2 annexed to the Universal Copyright Convention as signed at Geneva on 6 September 1952 concerning the application of that Convention the works of certain international organizations (September 16, 1955)
- Universal Copyright Convention of 6 September 1952, with Appendix Declaration relating to Article XVII and Resolution concerning Article XI (September 16, 1955)
- Protocol 3 annexed to the Universal Copyright Convention as signed at Geneva on 6 September 1952 concerning the effective date of instruments of ratification or acceptance of or accession to that Convention (September 1, 1954)
- Agreement on the Importation of Educational, Scientific and Cultural Materials (August 14, 1954)

Membership in regional IP-related treaties:

- Inter-American Convention on the Rights of the Author in Literary, Scientific and Artistic Works (August 25, 1953)
- General Inter-American Convention for Trade Mark and Commercial Protection (August 14, 1931)

APPENDIX B

SAMPLE INTERVIEW/SURVEY OUTLINES AND QUESTIONS

Sample Questions: ICT Organizations and cellular providers

1. What is crowdsourcing?
2. What is your process for codifying information?
3. How do you prioritize data?
4. Do you play a role in coordinating and dispatching emergency responses?
5. Does the state play a role in that process?
6. What is your relationship with the state?
7. How do you think your work fits into the reconstruction effort?
8. Do you feel that your technologies engage a wider part of the population than do more simple technologies such as radio?

Sample Questions: Planning/Development Agencies

1. How has your organization made use of crowd-sourced data via the state?
2. Have you started your own crowd-sourced initiative to collect data or have you used publicly available data?
3. How have you incorporated this data into your planning process?
4. Do you share your data?
5. What is your opinion of crowd-sourced data?
6. Do you feel it is accurate or truly reflective of the populations you are serving?

Sample Questions: Government Agencies

1. How long have you been working for Ministry X? Were you working here before the earthquake?
2. What is your understanding of crowd-sourced technologies? Do you see this as a useful tool for informing your work? Why or why not?
3. Do you think that crowdsourced data accurately represents your constituents? Do you think that this type of data is "authentic"?
4. Have you ever used or accessed information from Ushahidi or Noula? If not, why?
5. How has your roles and duties in the Ministry changed since the earthquake?
6. Have you been required to learn new technologies or software's during your time in Ministry X, if so can you give a list of particular software's?